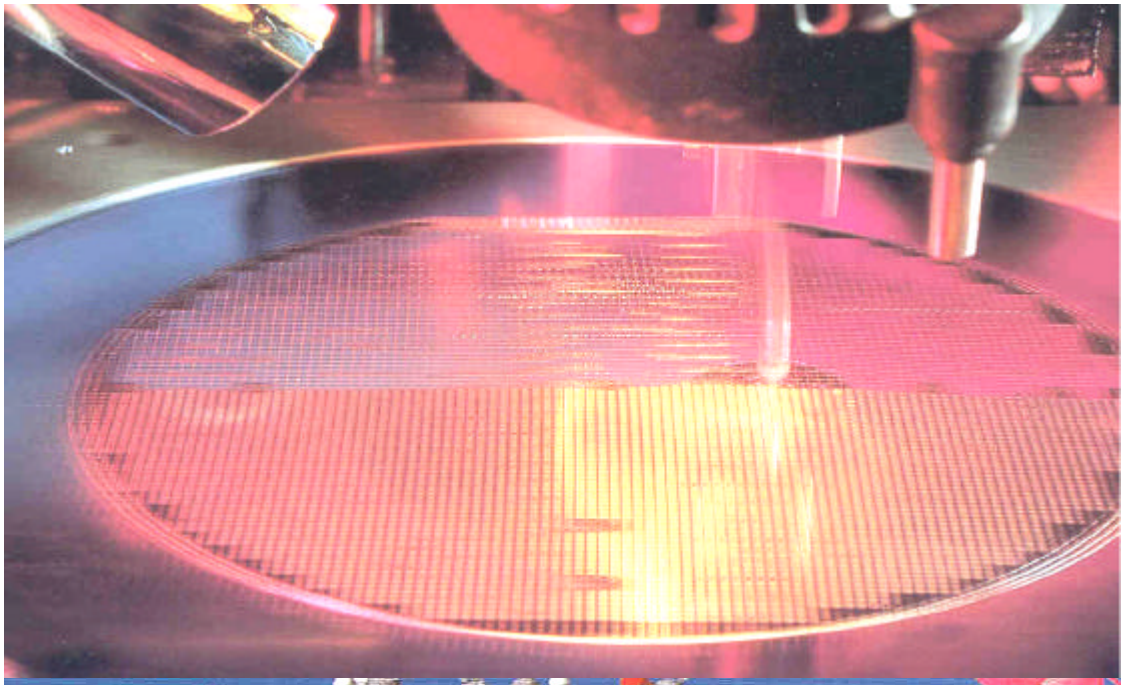

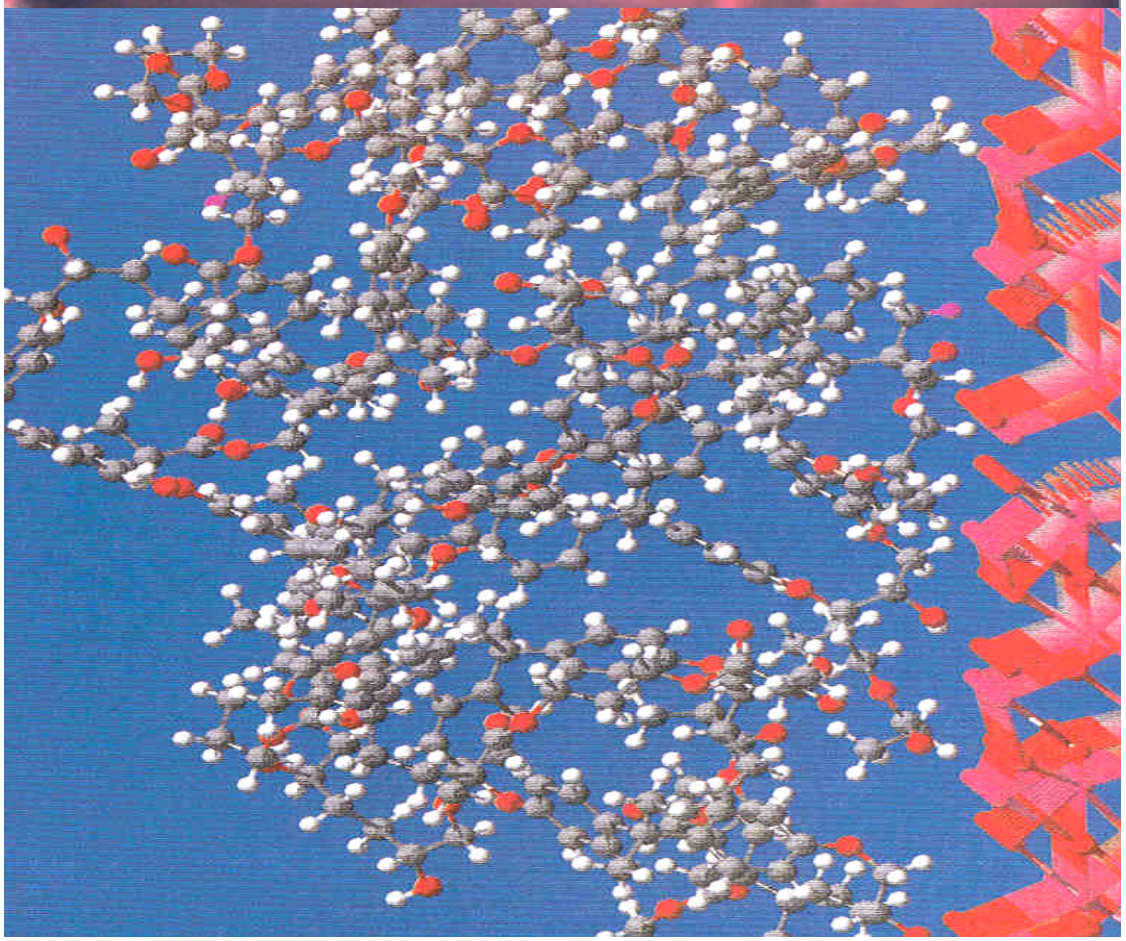

Mobile Anorad Gantry System

User and Maintenance Manual

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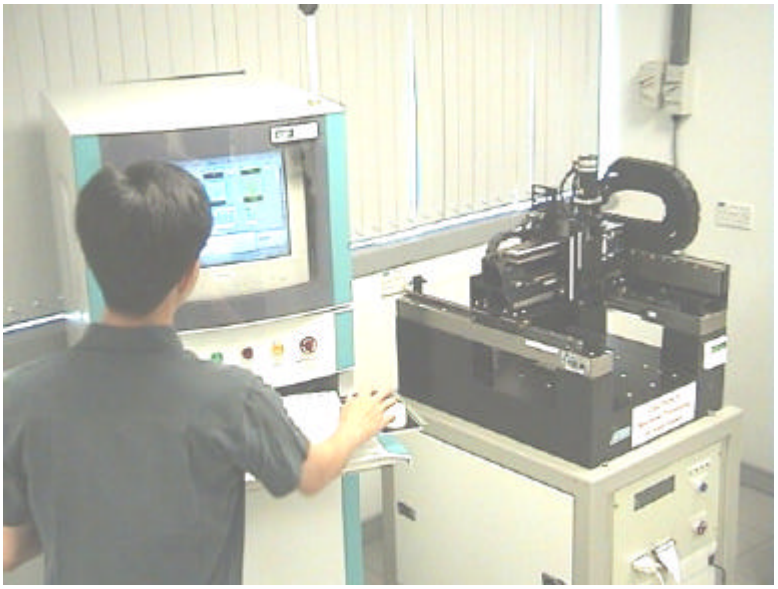
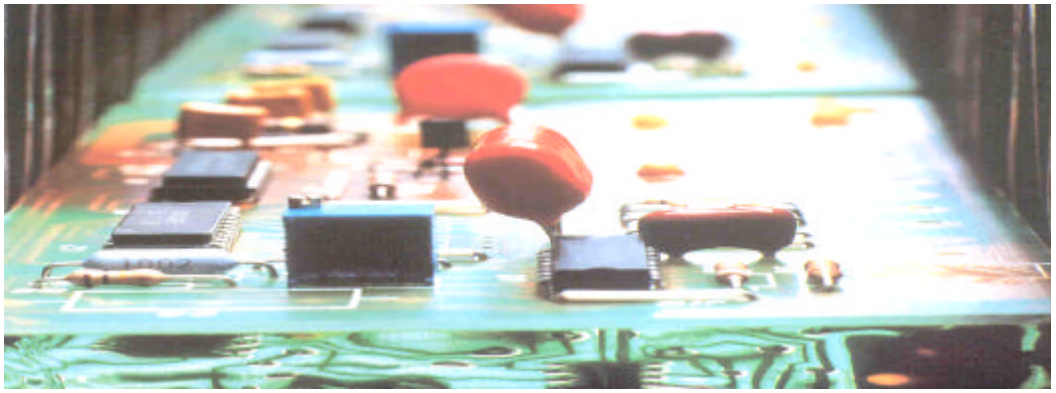
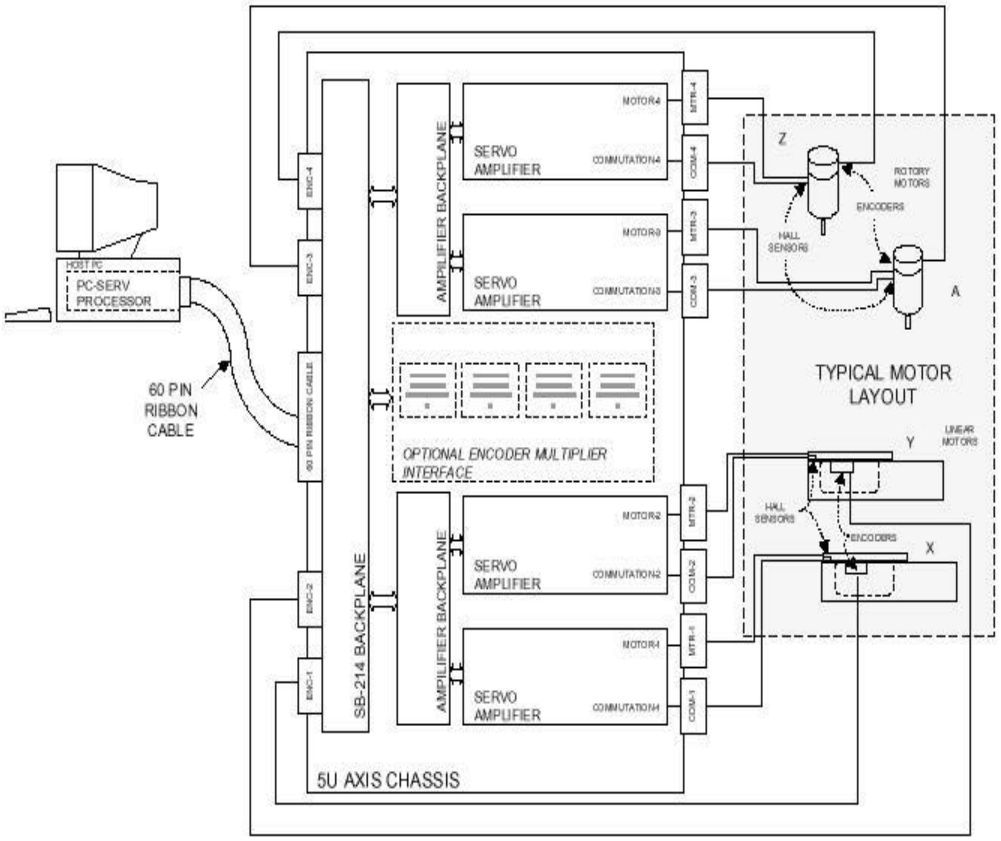
1 Introduction

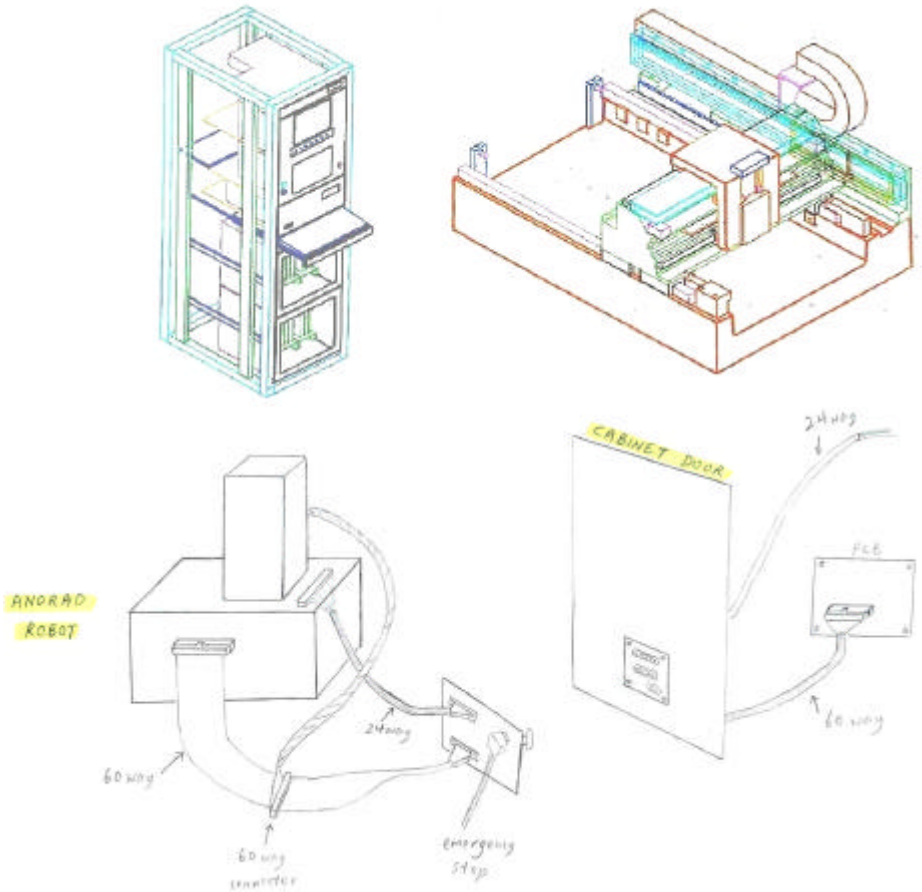
The User and Maintenance Manual is written for the design engineer or technician who will connect and operate the Mobile Anorad Gantry System.



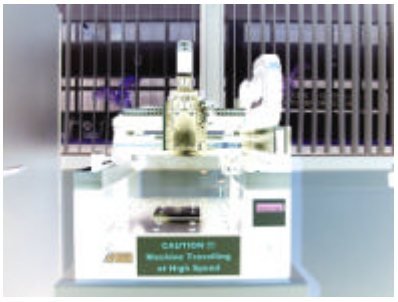




Overall System Layout of the HPMC PC and Anorad Gantry System



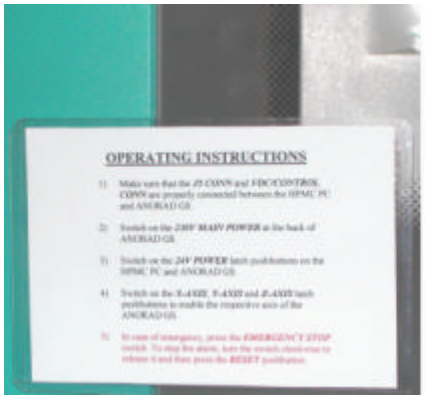
Draft Layout Sketch of the HPMC PC and Anorad Gantry System

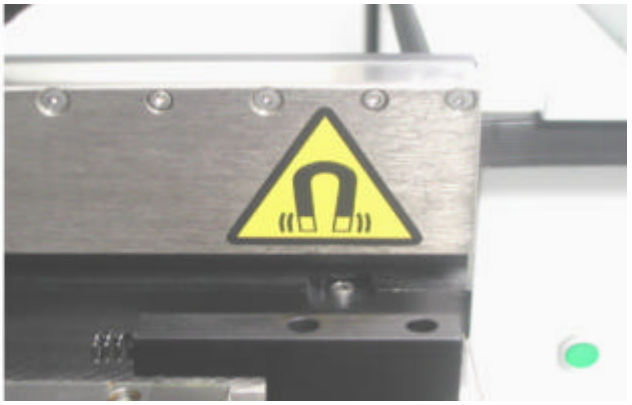


- Go to: http://www.anorad.com/onlineCatalog/gantryxy.htm for the Anorad Gantry System's Specifications and Outline drawings.
- Go to: http://www.anorad.com/technicalSupport/5UAxisChassis.pdf for the 5U Axis Chassis PC Serv Configuration Hardware Maintenance Manual.
- Go to: http://www.anorad.com/technicalSupport/highVoltageBrushless.pdf for the Z-axis High Voltage Brushless D.C. Servo Amplifier Hardware Maintenance Manual.

1.1 Warning Messages

Various warning messages are placed on various strategic locations of the HPMC PC workstation and the Mobile Anorad Gantry System to warn and guide the engineer as well as the operator to safely operate the entire machine setup. Below are some of the messages:



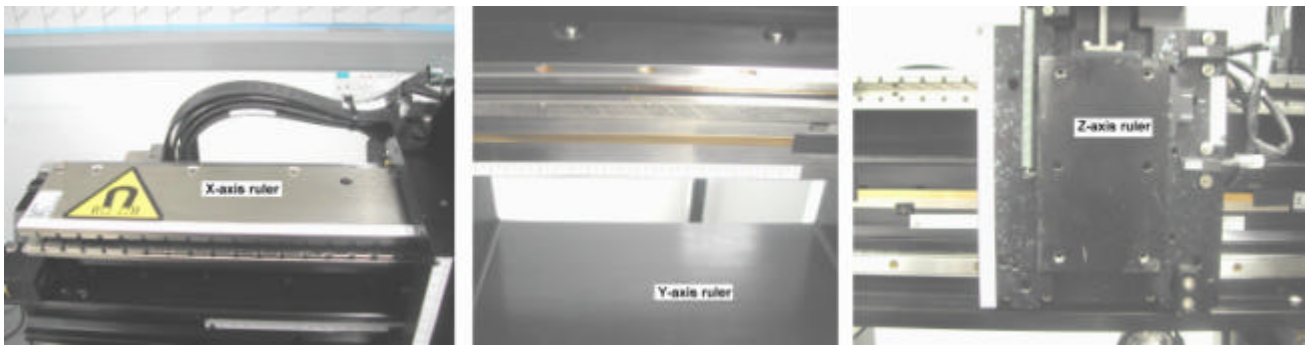


The warning messages will also be heard via the two speaker systems installed in the HPMC PC cabinets as shown on the right.

1.2 Machine Status Information

Machine status tags are placed on the HPMC PC indicating "UP / DOWN" and on the Anorad Gantry System indicating "PRODUCTION / MAINTAINANCE".
They are very useful when the machine breaks down or when it requires maintenance. It will prevent personnel from accidentally powering up the machine which can be disastrous.

In order to have a rough guide on the distance traveled by the X, Y and Z-axis, rulers (up to a precision of 1 mm) are mounted on the X, Y and Z-axis as shown below.



1.2 Security

In addition to the password protected screen saver, both the front and back doors of the HPMC PC wo rkstation can be locked to prevent any unauthorized access to the machine setup. In case the keys are lost, a set of spare keys are enclosed in the emergency glass container. Break the glass to retrieve the spare keys inside during emergency.

2 SAX-5/230 Digital Servo Amplifier (X & Y Axis)

The Saxophone series of servo amplifiers for Permanent Magnet Synchronous Motors (PMSM) incorporates digital velocity loop, digital current loop and sinusoidal commutation. Permanent Magnet Synchronous Motors, or Brushless AC (DC) motors (BLM) are used in high performance drives for machine tools and robotics. Independent control of the magnetic flux and the torque-generating current component in motors is provided by sinusoidal control with phase advance algorithms.

The advantages of sinusoidal control are:

1) High motor efficiency due to flux vector control.
2) Smooth torque operation (low torque ripple) even at very low speed enables high positioning accuracy.
3) Good velocity control under varying load conditions

The Saxophone series' basic configuration comprises a velocity amplifier with digital velocity loop targeting the OEM market. All adjustments of the velocity, current, and PID-filter are done via the communication line (using a PC), eliminating the need for trimmers. The Saxophone's power source is either a 3 phase 400 VAC line (SAX-xx/400) or a 1 or 3 phase 230 VAC line (SAX-xx/230).

The control and auxiliary supplies are derived from a 24V AC/DC supply, which is isolated from the DC power bus. This feature provides a safe and economical "power back-up" which is essential for position systems. The Saxophone series meets UL508c and the relevant CE regulations.

The detail User manual of SAX-5/230 Digital Servo Amplifier can be found in the website: http://www.elmomc.com/support/manuals/MAN_SAX_UG_EN_0601.pdf

2.1 General Structure and Connection

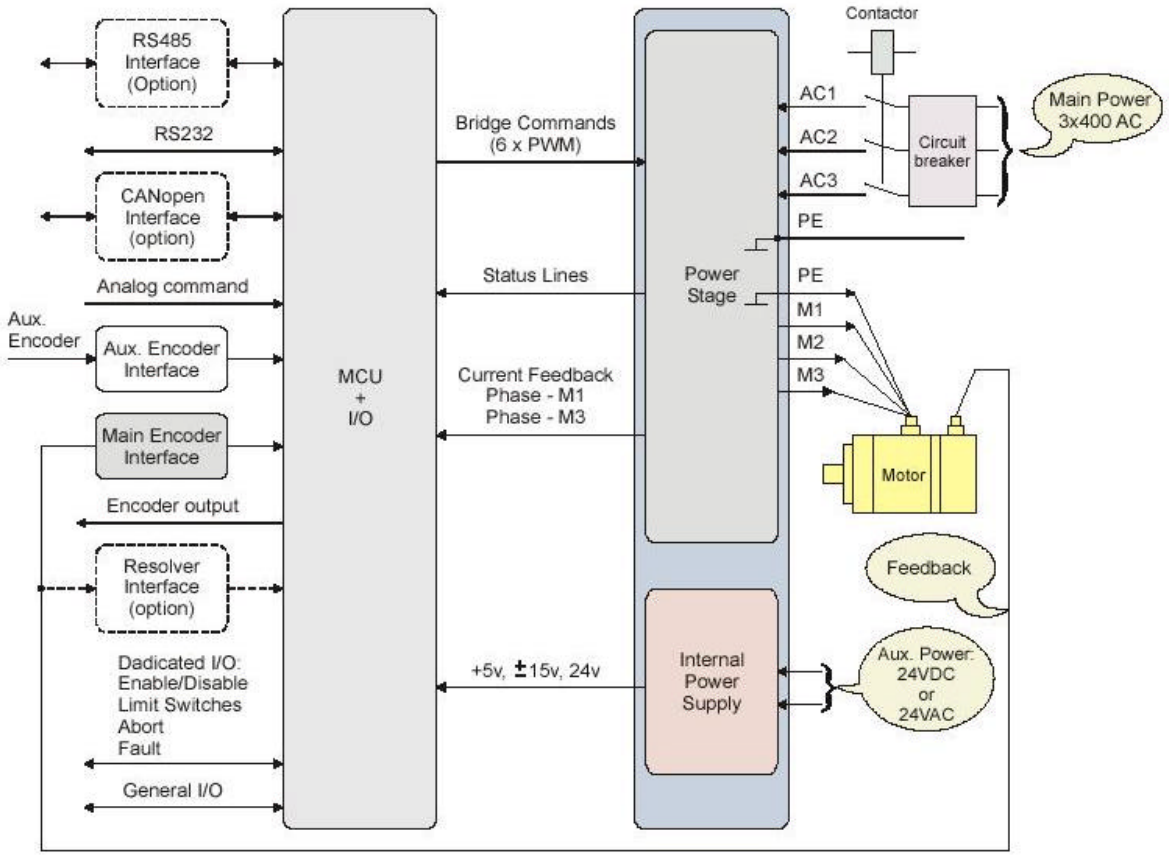


Figure 1: Dedicated I/O

For three phases supply voltage:

- The circuit breaker current rating should be between 150% to 200%, of the amplifier's current.
- The circuit breaker voltage rating should be 460 VAC.
- The contactor should be up to 150% of the amplifier's current.

For one phase supply voltage:

- The circuit breaker current rating should be between 200% to 300%, of the amplifier's current.
- The circuit breaker voltage rating should be 460 VAC.
- The contactor should be up to 200% of the amplifier's current.

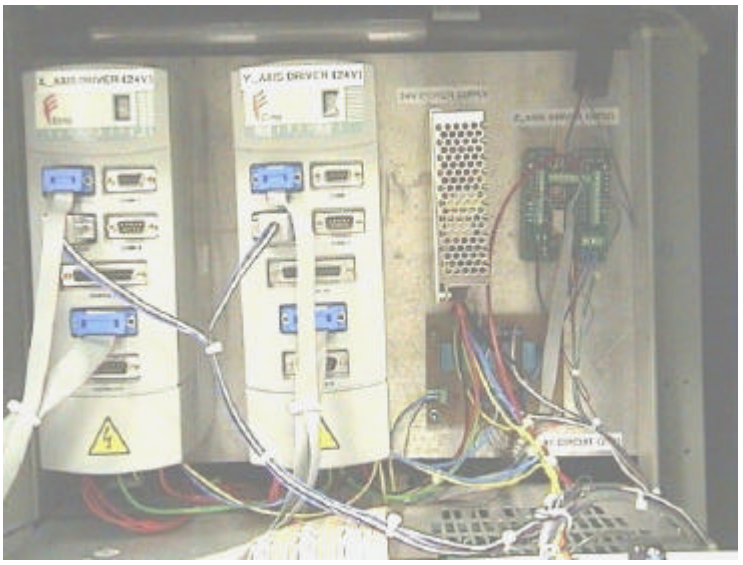
2.2 Dedicated Features

Feature	
CANopen interface	No
Current mode	Yes
Velocity mode	Yes
Velocity follower	Yes
Two encoder inputs	Yes
Two analog inputs	Yes
Executable commands	Yes
Point to point	No
Position Follower	No
Position jog	No
ECAM	No
PT	No
PVT	No
Event capturing	No
Dual loop	No
User program size	2 Kbyte
General inputs	2
General outputs	2

Table 1: Dedicated features

2.3 Connections

The Figures below show the front panel of the Saxophone.



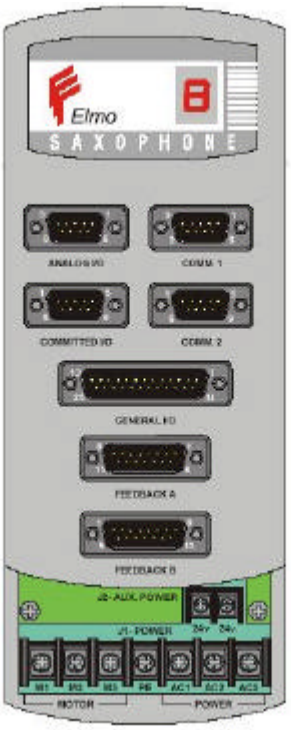


Figure 2: Panel Layout

2.4 Connector Types

Table summarizes the different types of connectors used by the Saxo phone.

Type	Used for	Remarks
7 pin terminal	Main Power	Mains, Motor power
2 pin terminal	Auxiliary Power	Logic power supply
9 pin D-type male	Committed I/O	Enable, Abort, Limits
25 pin D-type female	General I/O	Programmable I/O
15 pin D-type female	Feedback A	Encoder Option
15 pin D-type female	Feedback A	Resolver Option
9 pin D-type female	Analog I/O	
9 pin D-type female	Comm. 1	RS-232 or RS-485 interface
9 pin D-type male	Comm. 2	CAN interface
15 pin D-type male	Feedback B	Aux. Encoder, Encoder Output

Table 2: Connector Types

2.5 Wiring and Mounting

2.5.1 Wiring

Proper wiring, grounding and shielding techniques are important in obtaining good servo operation and performance. Incorrect wiring, grounding or shielding can cause erratic servo performance or even complete failure.

1) Keep motor wires as far as possible from the signal level wiring (feedback signals, control signals, etc.).

2) If additional inductors (chokes) are required, keep the wires between the amplifier and the chokes as short as possible.

3) Minimize lead lengths as much as it is practical. Although the amplifier is protected against long (inductive) supply wires, it is recommended to keep the leads as short as possible. For cable length of over 10m (35 feet) consult factory for more technical instructions.

4) It is recommended to use twisted and shielded wires whenever it is possible to do so in the wiring diagrams. Avoid running these leads in close proximity to power leads or other sources of EMI noise.

5) All grounded components should be tied together at a single point (star connection). This point should then be tied with a single conductor to an earth ground point.

6) After wiring is completed, carefully inspect all conditions to ensure tightness, good solder joints, etc.

2.5.2 Mounting

For optimum heat dissipation the amplifier has to be mounted in vertical position. A clearance of at least 10cm (4”) should be left at both top and bottom of the unit.

2.6 Connectors

The following sections provide the pin outs for the Saxophone connectors. Schematics for certain cables are also provided.

2.6.1 X and Y-Axis Driver Main Power Connector

Pin #	Signal	Colour	X-Axis Driver Connected to	Y-Axis Driver Connected to
1	AC3	------	not connected	not connected
2	AC2	Red	Live (230V)	Live (230V)
3	AC1	Black	Neutral	Neutral
4	PE	Green	Earth	Earth
5	M3	Red	A3	A3
6	M2	Red	A2	A2
7	M1	Red	A1	A1

Table 3: Main Power Connection Pinout

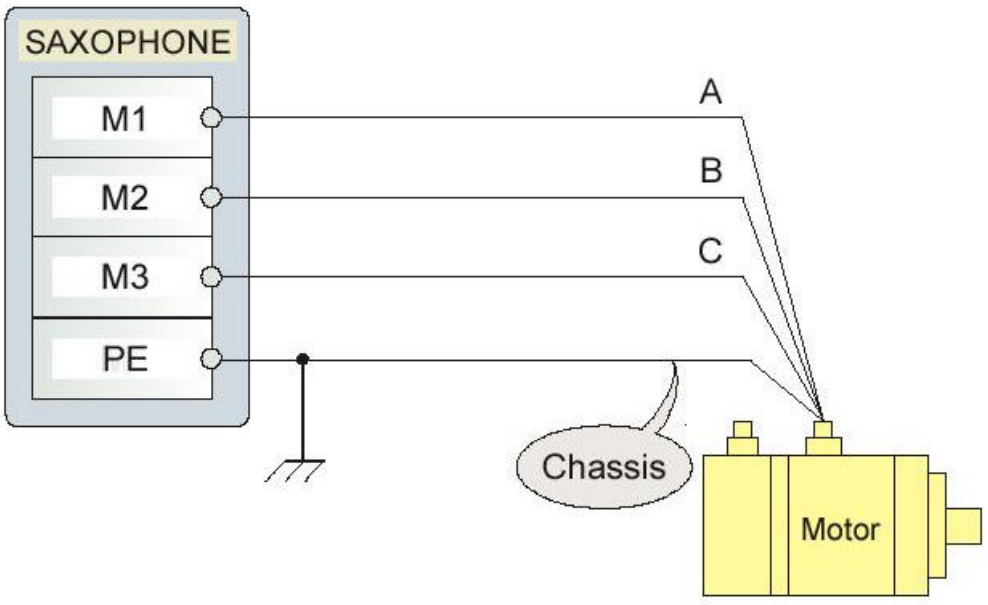


Figure 3: Motor Power Connection

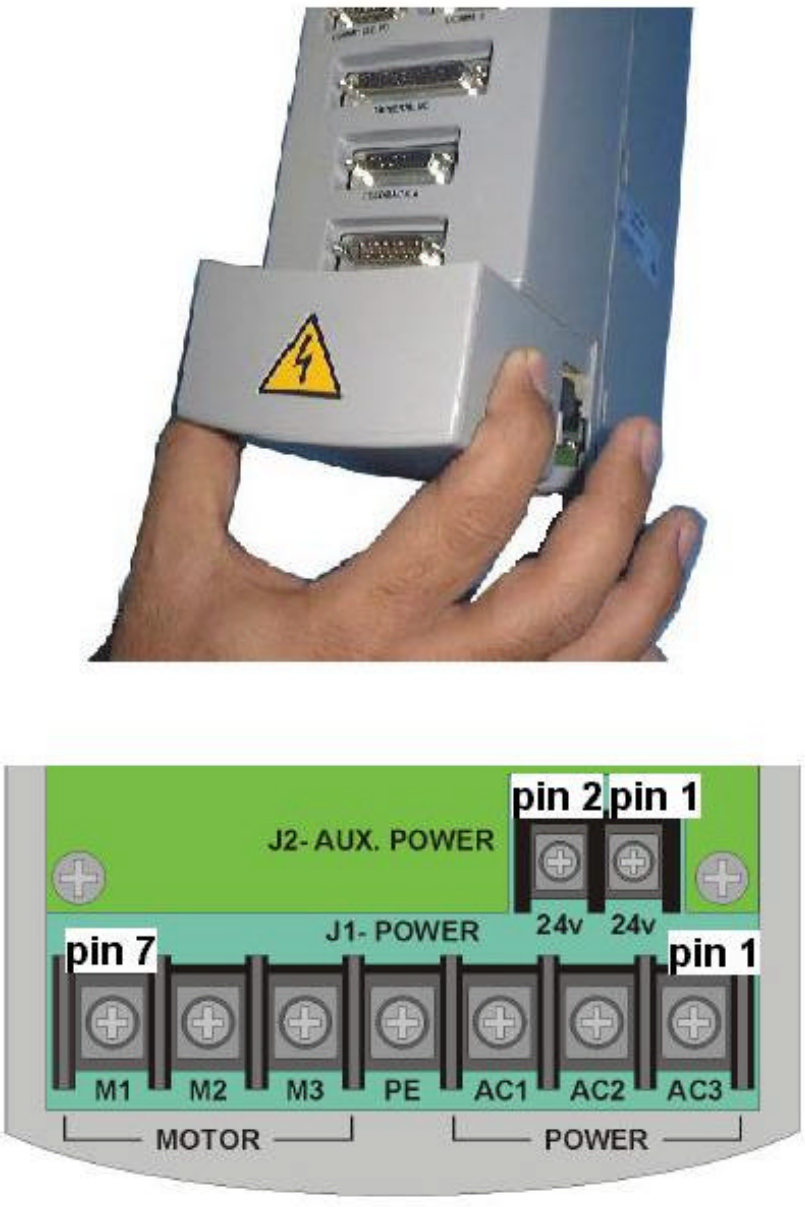


Figure 4: Power Terminal Connections

2.6.2 Auxiliary Power Connector

Pin #	Signal	Colour	Connected to
1	APS1 (24V)	Red	Pin 5 of the 24V Power Supply
2	APS2 (24V)	Black	Pin 4 of the 24V Power Supply

Table 4: Auxiliary Power Connection Pinout

2.6.3 Committed I/O Connector

Pin #	Signal	Function
1	FLS	Forward limit switch
2	RLS	Reverse limit switch
3	LSRET	Limit switch return (connected to GND)
4	ENABLE	Amplifier Enable (Disabling resets any protective latch)
5	ENRET	Amplifier Enable Return (connected to GND)
6	STOP	Applying power to this terminal will stop the motor at maximum deceleration
7	STRET	Stop Return (connected to GND)
8	FAULT	Fault Relay
9	FAULT	Fault Relay

Table 5: 9 Pin D_Type Male Connector Pinout

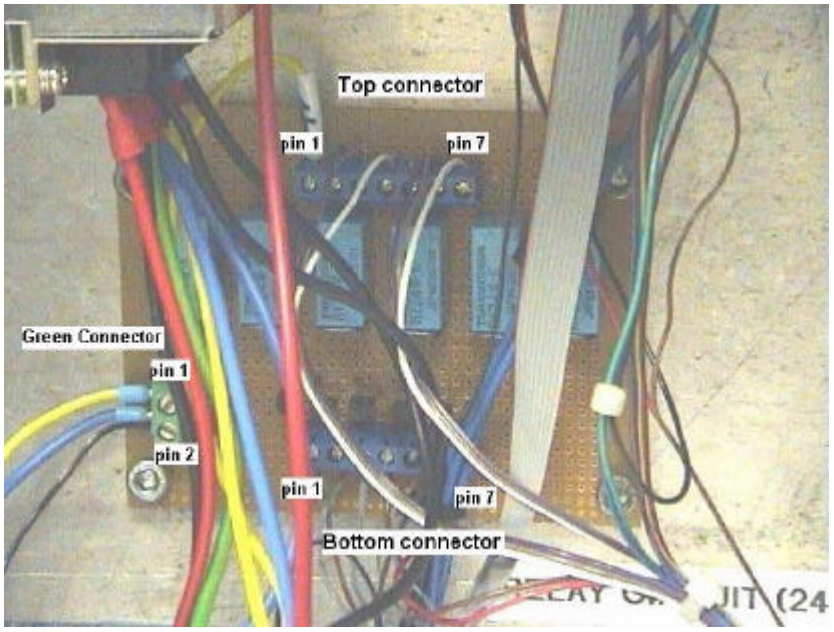


Figure 5: SAX-5/230 Servo Amplifier Relay Circuit

2.6.4 X Axis Committed I/O Connector

Pin #	Signal	Colour	Connected to
1	FLS	Purple	Pin 2 of the Relay circuit Top connector
2	RLS	Grey	Pin 3 of the Relay circuit Top connector
4	ENABLE	White	Pin 4 of the Relay circuit Top connector
5	ENRET	Black	Pin 4 of the 24V Power Supply
6	STOP	Blue	Pin 1 of the Emergency Stop switch

Table 6: X Axis 9 Pin D_Type Male Connector Pinout

2.6.5 Y Axis Committed I/O Connector

Pin #	Signal	Colour	Connected to
1	FLS	Purple	Pin 5 of the Relay circuit Top connector
2	RLS	Grey	Pin 6 of the Relay circuit Top connector
4	ENABLE	White	Pin 7 of the Relay circuit Top connector
6	STOP	Blue	Pin 1 of the Emergency Stop switch
7	STOPRET	Black	Pin 4 of the 24V Power Supply

Table 7: Y Axis 9 Pin D_Type Male Connector Pinout

2.6.6 Feedback A Connector - Encoder Option

Pin #	Signal	Function
1	HC	Hall sensor C input
2	HA	Hall sensor A input
3	SUPRET	Hall/Encoder supply voltage return
4	+5V	ENCODER/HALL +5V supply voltage (See Table 25)
5	CHA-	Channel A complement
6	CHA	Channel A
7	INDEX-	Index complement
8	INDEX	Index
9	SUPRET	Supply return
10	HB	Hall sensor B input
11	SUPRET	Supply return
12	+15V	HALL +15V supply voltage (See Table 25)
13	SUPRET	Supply return
14	CHB-	Channel B complement
15	CHB	Channel B

Table 8: 15 Pin D_Type Female Connector Pinout

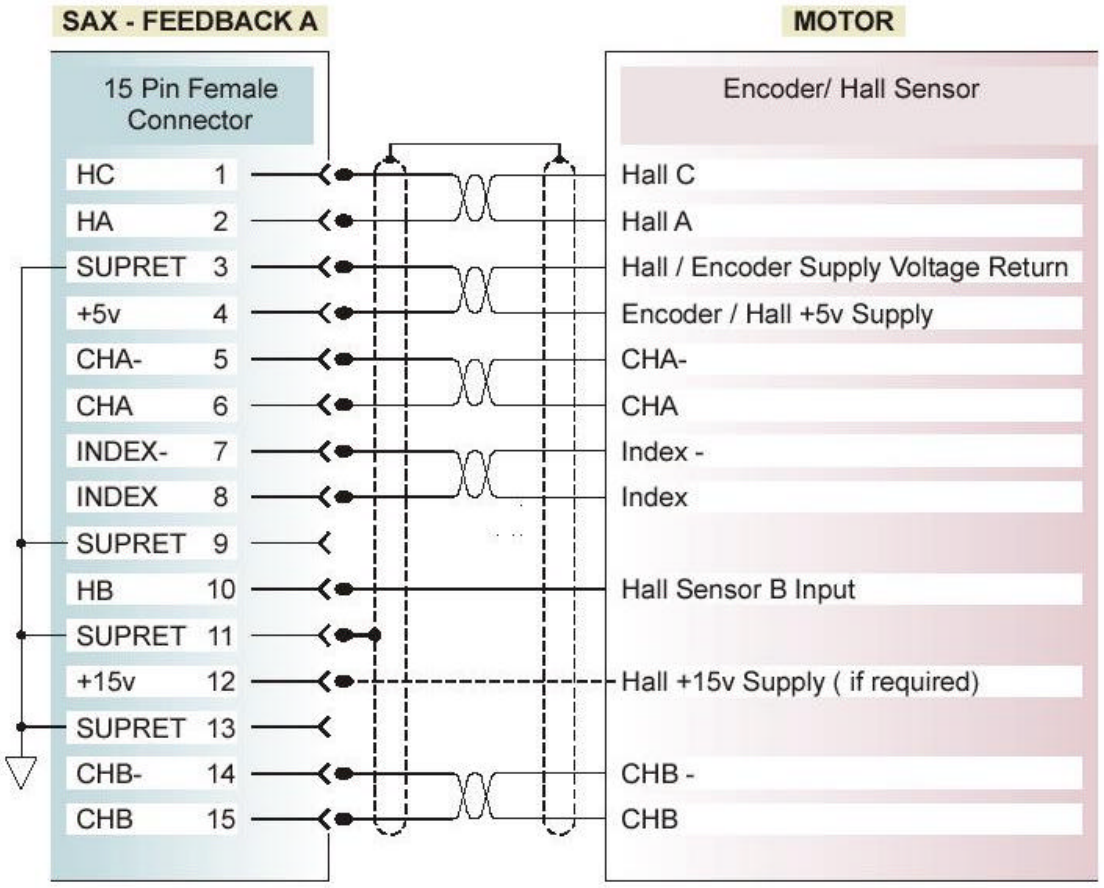


Figure 6: Encoder / Hall sensor Pin Assignment

2.6.7 X Axis Feedback A Connector

Pin #	Signal	Colour	Connected to
5	CHA-	Grey	Pin 12 of the J5 connector
6	CHA	Grey	Pin 11 of the J5 connector
13	SUPRET	Grey	Pin 2 of the J5 connector
14	CHB-	Grey	Pin 14 of the J5 connector
15	CHB	Grey	Pin 13 of the J5 connector

Table 9: X Axis 15 Pin D_Type Female Connector Pinout

2.6.8 Y Axis Feedback A Connector

Pin #	Signal	Colour	Connected to
3	SUPRET	Grey	Pin 28 of the J5 connector
5	CHA-	Grey	Pin 24 of the J5 connector
6	CHA	Grey	Pin 23 of the J5 connector
14	CHB-	Grey	Pin 26 of the J5 connector
15	CHB	Grey	Pin 25 of the J5 connector

Table 10: Y Axis 15 Pin D_Type Female Connector Pinout

2.6.9 Analog I/O Connector

Pin #	Signal	Function
1	ANLIN1+	Analog input 1
2	ANLIN1-	Analog input 1
3	ANLRET	Analog Ground
4	ANLIN2+	Analog input 2
5	ANLIN2-	Analog input 2
6	GND	Circuit common
7	ANLOUT	Analog output
8	ANLRET	Analog Ground
9	GND	Circuit common

Table 11: 9 Pin D_Type Female Connector Pinout

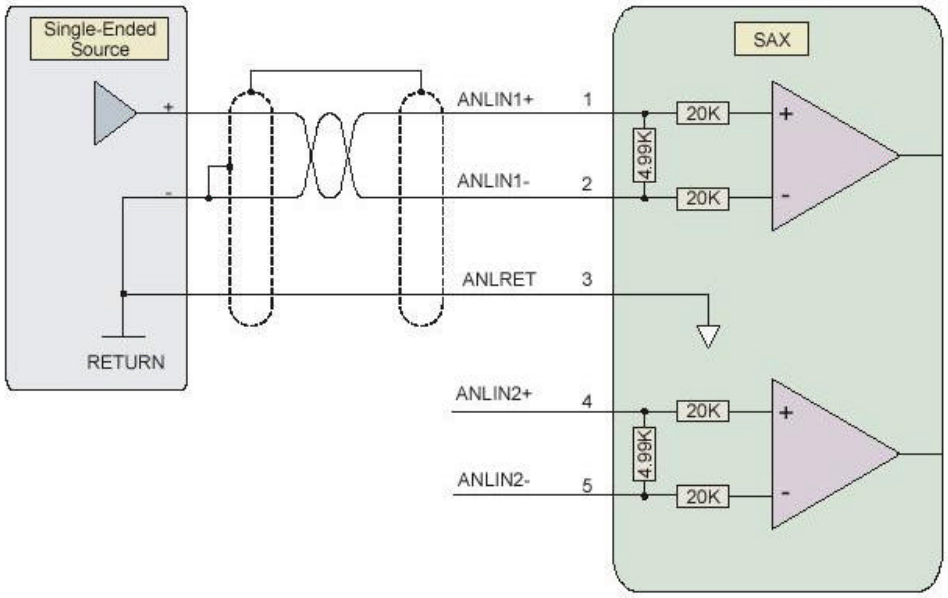


Figure 7: Analog input with single-ended source

2.6.10 X Axis Analog I/O Connector

Pin #	Signal	Colour	Connected to
1	ANLIN1+	Grey	Pin 5 of the J5 connector
3	ANLRET	Grey	Pin 6 of the J5 connector

Table 12: X Axis 9 Pin D_Type Female Connector Pinout

2.6.11 Y Axis Analog I/O Connector

Pin #	Signal	Colour	Connected to
1	ANLIN1+	Grey	Pin 17 of the J5 connector
3	ANLRET	Grey	Pin 18 of the J5 connector

Table 13: Y Axis 9 Pin D_Type Female Connector Pinout

2.6.12 Comm. 1 Connector

Pin #	Signal	Function
1		N.C.
2	Tx	RS232 Transmit
3	Rx	RS232 Receive
4		N.C.
5	COMRET	Communication Return
6	TR+	RS485 TR+ (an option)
7	TR-	RS485 TR- (an option)
8		N.C.
9		N.C.

Table 14: Comm. 1 - 9 Pin D_Type Female Connector Pinout

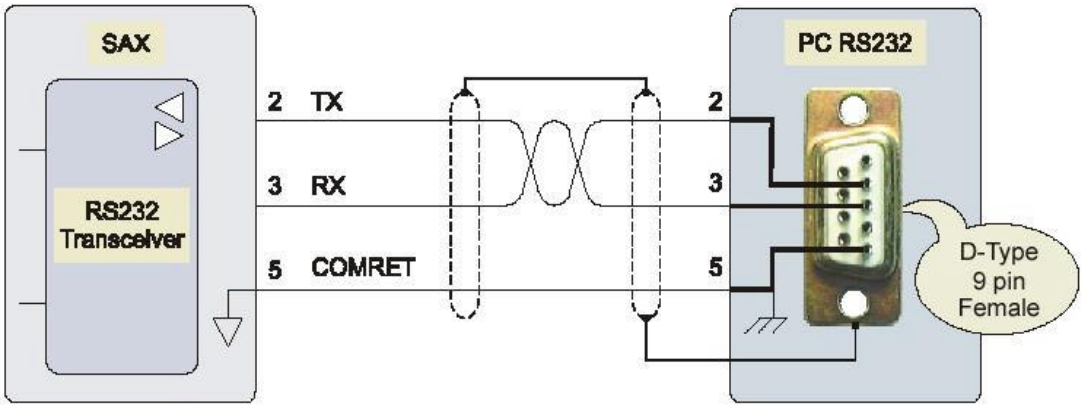


Figure 8: RS232 Interface

2.7 Power Up

Before applying power, make sure that the AC supply is within the unit's specifications i.e. nominal operating AC voltage of 230VAC and rated phase continuous RMS current of 5A.

Type	Phase RMS Continuous Current Amperes*	Phase RMS Peak Current Amperes*	Nominal Operating Voltage VAC	DC Bus Over Voltage Protection Volts	DC Bus Under Voltage Protection Volts	Shunt Current Amperes
SAX-3/230	3	5	1x230 or 3x230	390	78	4.0
SAX-5/230	5	10	1x230 or 3x230	390	78	4.0
SAX-8/230	8.5	17	1x230 or 3x230	390	78	8.0

Table 15: 1 or 3x230V AC Types Power Ratings

2.7.1 Voltage supply

The Saxophone SAX-5/230 is designed to **operate from a 1-phase voltage sourc**e. It can be connected directly to the line voltage. It is not necessary to use an isolation transformer.

Rated Specifications	Unit	SAX-xx/230	SAX-xx/400
Rated supply voltage	VAC	3 x 240 + max10%	3 x 460 max
Pulse power of ballast circuit	kW	1.5/3	5/10
Continuous power of ballast circuit	W	80/160	80/160
Switch-off threshold at over voltage	VDC	390	765
Inrush current limit	A	<85	<140
Efficiency @ Rated POWER	%	>95	>97

Table 16: Main Power Supply Ratings

Auxiliary Power Supply Source	The source of the auxiliary power supply can be AC or DC source.
AC input	AC voltage input: 18 $V_{AC} < V_{IN(AC)} < 28\ V_{AC}$
DC Input	DC voltage input: 18 $V_{DC} < V_{IN(DC)} < 40\ V_{DC}$
Power rating of the source	40 VA
Input frequency	Input Frequency: 45 Hz < f_{IN} < 500 Hz.

Table 17: Auxiliary Power Supply Ratings

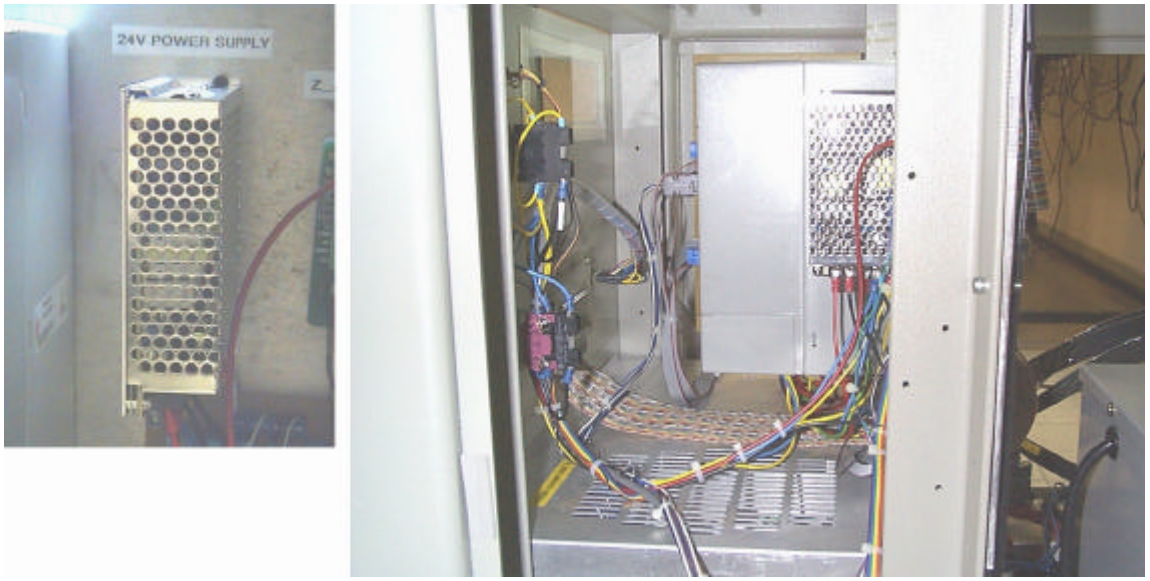
Analog Input - differential mode voltage	+ / - 20V max.
Analog Input - common mode voltage	+ / - 10V max.
Input Resistance	5K
Analog Output voltage	+ / - 10V max. (10KΩ impedance)
Analog Output accuracy	+ / - 3%

Table 18: Analog I/O Ratings

Encoders Supply Voltage	5V + / - 5%
Hall Effect Supply Voltage	5V or 15V + / - 5%
Encoder Supply Current (pin 4 of feedback A and B)	300mA max. (Total for both outputs)
Hall Effect Supply Current	50mA max.

Table 19: Encoder and Hall Effect Ratings

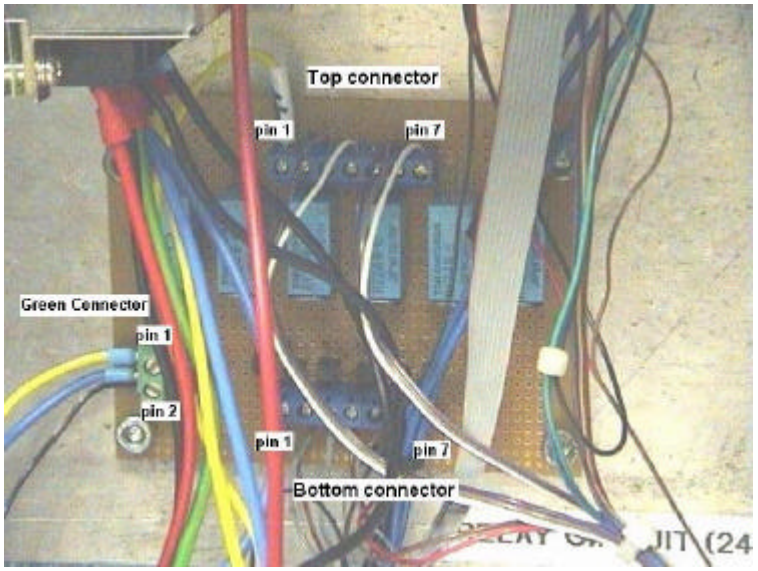
2.8 24V Power Supply



Pin #	Signal	Colour	Connected to
1	LIVE	Red	Pin 2 of the X and Y-axis Driver Main Power Connector
2	NEUTRAL	Black	Pin 3 of the X and Y-axis Driver Main Power Connector
3	EARTH	Green	Pin 4 of the X and Y-axis Driver Main Power Connector
4	GROUND	Blue	Pin 5 of the X-axis Committed I/O connector Pin 7 of the Y-axis Committed I/O connector Pin 2 of the Relay Circuit Green connector
5	24V	Yellow	Pin 1 of the Relay Circuit Green connector Pin 1 of the Relay circuit Top connector Pin 2 of the Emergency Stop switch

Table 20: 24V Power Supply (for enabling X and Y axis)

2.9 24V Relay Circuit



Pin #	Connected to
Green Connector	
1	Pin 5 of the 24V Power Supply
2	Pin 4 of the 24V Power Supply
Top Connector	
1	Pin 5 of the 24V Power Supply
2	Pin 1 of the X-axis Committed I/O connector
3	Pin 2 of the X-axis Committed I/O connector
4	Pin 4 of the X-axis Committed I/O connector
5	Pin 1 of the Y-axis Committed I/O connector
6	Pin 2 of the Y-axis Committed I/O connector
7	Pin 4 of the Y-axis Committed I/O connector
Bottom Connector	
1	Pin 2 of the J5 connector
2	Pin 8 of the J5 connector
3	Pin 7 of the J5 connector
4	Pin 3 of the J5 connector
5	Pin 20 of the J5 connector
6	Pin 19 of the J5 connector
7	Pin 15 of the J5 connector

Table 21: Relay Circuit (for enabling X and Y axis)

2.10 Emergency Stop Switch

Pin #	Connected to
1	**Pin 6 of the X-axis Committed I/O connector** **Pin 6 of the Y-axis Committed I/O connector**
2	**Pin 5 of the 24V Power Supply**

Table 22: Emergency Stop switch

2.11 Saxophone Setup and Initialization

After completing all the connections, it is necessary to setup and initialize the system. For description of the initial setup and initialization for the Saxophone using Elmo's Composer Software, please refer to the Composer Software Manual in the website: www.elmomc.com/support/manuals/MAN_CMP_UG_EN_0102.pdf.

3 PIC 15/200 Brushless Motor Servo Amplifier (Z Axis)

The PICCOLO series of miniature servo amplifiers for brushless DC Motors is designed for motion systems where the motor's trapezoidal commutation is performed by the amplifier. The servo amplifier incorporates custom mixed analog/digital ICs and hybridized power stage. The basic configuration is a current mode amplifier. No trimmers are used in the basic version. It meets UL508c and the suitable CE regulations.

The power stage is implemented on a single ceramic substrate. This design enables very high thermal conductivity, high current carrying capacity, better EMC and good mechanical strength. The control section is implemented by dedicated custom ICs that contribute to higher reliability because fewer components are used and improved performance due to the high level of integration.

The detail User manual of PIC 15/200 Brushless Motor Servo Amplifier can be found in the website: http://www.elmomc.com/support/manuals/MAN_PIC_UG_EN_0599.pdf

3.1 Standard Features

- Operation in current mode
- Internal DC to DC converter allows for operation from a single supply
- Zero dead band
- Excellent linearity
- 1 differential input
- Motor current monitor
- Current gain change for low inductance motors
- Current feedback multiplier for low current motors
- Status indication and remote control functions by three open collector transistors
- External continuous and peak current limits adjustments
- Interface via soldering pins
- Package: plated copper base plate, plastic housing, UL94V0 recognized

3.2 Fault Protection

- Short between the outputs or between each output and the Power Return.
- Over temperature
- Under/over voltage

3.3 Connectors Location

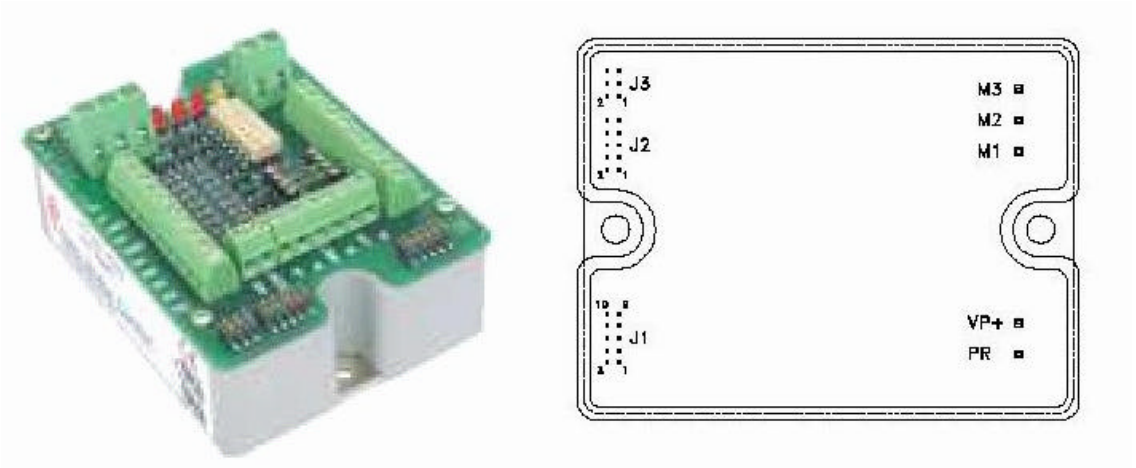


Figure 9: PIC 15/200 Connectors Location

3.4 Block Diagram

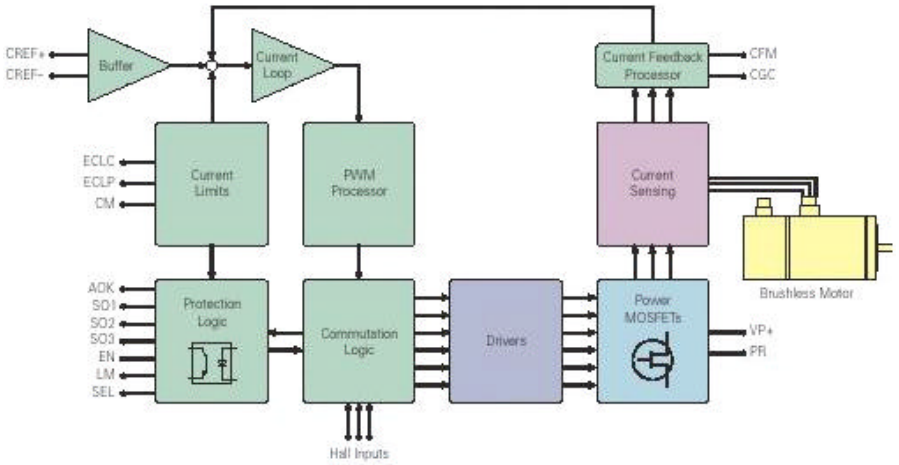


Figure 10: Block Diagram of the PIC 15/200

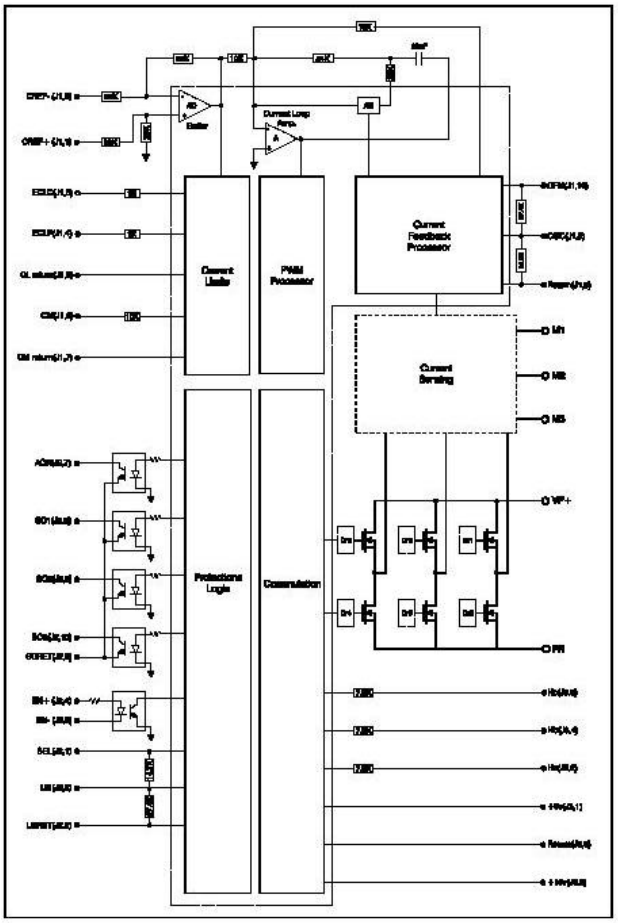


Figure 11: Detail Block Diagram of the PIC 15/200

3.5 Wiring Connections

Pin	Function	Remarks
VP+	Positive power Input	160 V
PR	Power input Return	GND
M_1	Motor power output 1	H1
M_2	Motor power output 2	H2
M_3	Motor power output 3	H3

Table 23: Power Connections

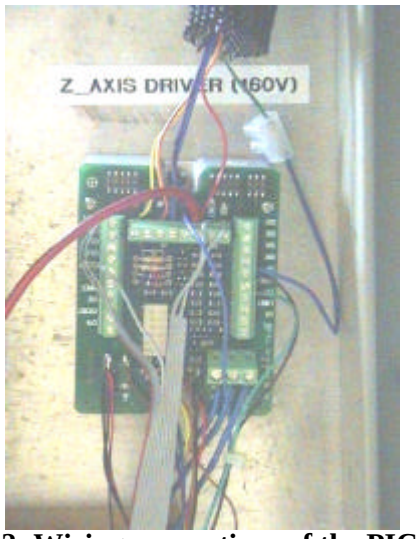


Figure 12: Wiring connections of the PIC 15/200

Figure 13: Location of the Z-axis COM 3 connector

Z Axis Driver Pin #	Signal	Connected to
3	CMRET	Pin 36 of the J5 connector
6	CREF+	Pin 35 of the J5 connector
7	CREF-	Pin 36 of the J5 connector
8	+VCC	Pin 29 of the J5 connector
9	VCCRET	Pin 27 of the J5 connector
--	+5V	Pin 1 of the Z axis COM 3 connector
--	Ha	Pin 7 of the Z axis COM 3 connector
--	HARET	Pin 6 of the Z axis COM 3 connector
--	Hb	Pin 2 of the Z axis COM 3 connector
--	Hc	Pin 3 of the Z axis COM 3 connector

Table 24: Wiring conne ctions of the PIC 15/200

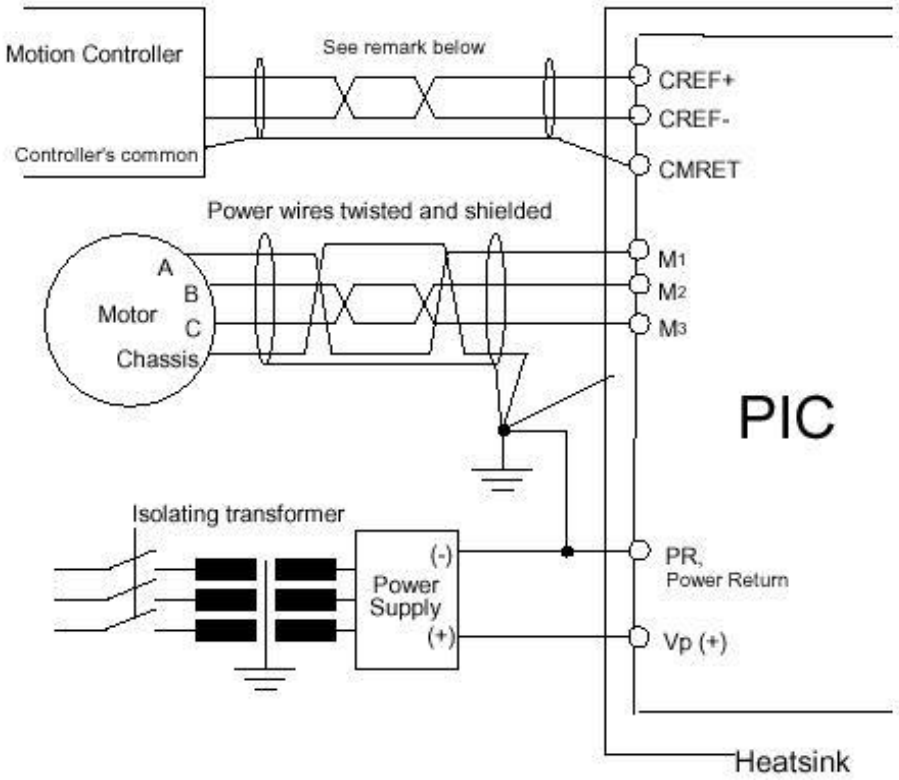


Figure 14: Wiring of the Z-axis Motor

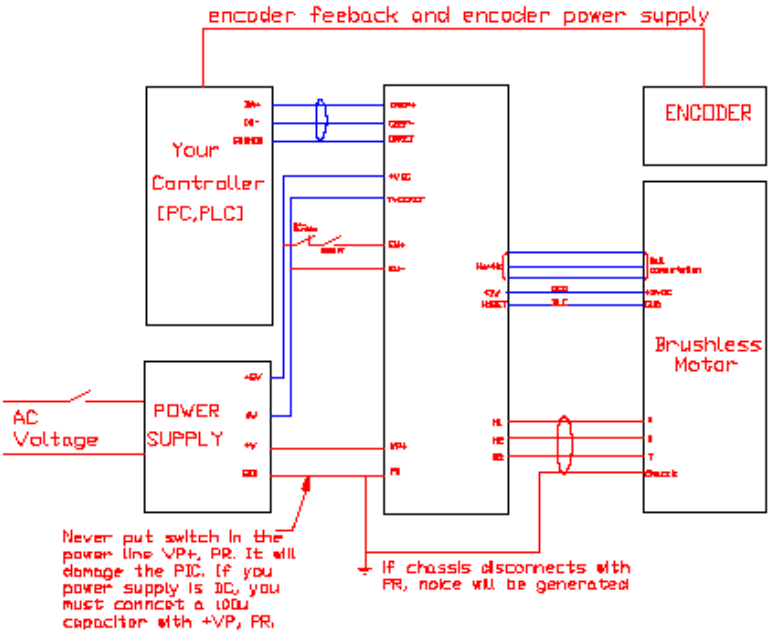


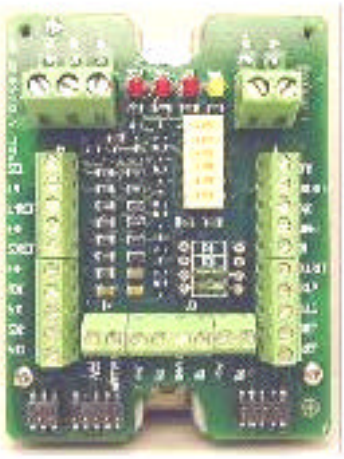
Figure 15: Actual wiring of the Z-axis Motor

3.6 Status Indication

	Function	Latch option	AOK	SO1	SO2	SO3
1	Amplifier OK (AOK)	N/A	Low	Open collector	Open collector	Open collector
2	External disable	No	Low	Low	Open collector	Low
3	Current limit	No	Low	Open collector	Open collector	Low
4	Short	Yes	Open collector	Low	Open collector	Low
5	Over temperature	Yes	Open collector	Open collector	Low	Low
6	Internal supplies protection	No	Open collector	Low	Low	Open collector
7	Under voltage	No	Open collector	Low	Open collector	Open collector
8	Over voltage	No	Open collector	Open collector	Low	Open collector
9	Shunt	No	Low	Open collector	Low	Open collector
10	Power Up Reset	No	Open collector	Open collector	Open collector	Open collector
11	Commutation Failure	Yes	Open collector	Low	Low	Low

Table 25: Status Indication of the PIC 15/200 for troubleshooting

3.7 PIC STARTER



The PIC STARTER is an add on interconnection board for the PIC servo amplifier that plugs on top of the amplifier. The purpose of this board is the translation of the PIC solder type pins into screw type terminals thus enabling easy connectivity for evaluation and low quantity applications. One to one relationship between board terminals and the pins of the PIC is kept.

The features of the PIC STARTER are as follows:

- Four LEDs allow convenient diagnostics of the PIC status outputs.
- The dedicated digital inputs can be activated by DIP switches.
- Scaling resistors are provided for adjusting the current limits and the command reference.

The detail User manual of PIC STARTER evaluation and interface board can be found in the website: http://www.elmomc.com/support/manuals/MAN_PIC_ST_EN_0899.pdf

Switch	Function	ON	OFF
S1	CGC	CGC – ON (see section 3.3 in "PIC Operating Manual)	CGC - OFF
S2	CFM	CFM – ON (see section 3.2 in "PIC Operating Manual)	CFM - OFF
S3	SEL	30° halls sensor format. (see section 3.7 in "PIC Operating Manual)	60° Halls Sensor Format.
S4	LM	LM – ON (see section 3.6 in "PIC Operating Manual)	LM – OFF
S5	EN+	Setting S5 to ON applies +VCC voltage to EN+ pin (If +VCC is applied to J4). Setting both S5 & S6 will enable the amplifier without an external signal.	No voltage is applied to EN+
S6	EN–	Setting S6 to ON connects VCCRET to EN- pin.	No voltage is applied to EN–

Table 26: DIP Switches settings of the PIC Starter

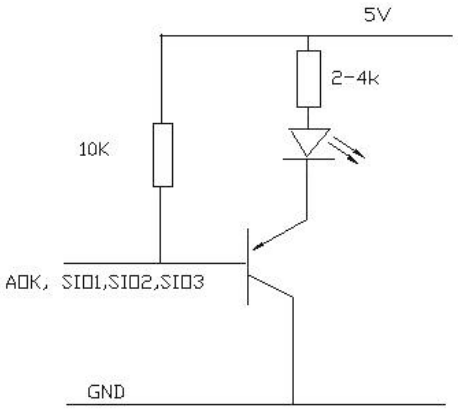


Figure 16: Circuit Diagram of the AOK, SO1, SO2 and SO3 LEDs

Function	Latch option	AOK	SO1	SO2	SO3
Amplifier OK (AOK)	N/A	ON	OFF	OFF	OFF
External disable	No	ON	ON	OFF	ON
Current limit	No	ON	OFF	OFF	ON
Short	Yes	OFF	ON	OFF	ON
Over temperature	Yes	OFF	OFF	ON	ON
Internal supplies protection	No	OFF	ON	ON	OFF
Under voltage	No	OFF	ON	OFF	OFF
Over voltage	No	OFF	OFF	ON	OFF
Shunt request	No	ON	OFF	ON	OFF
Power Up Reset	No	OFF	OFF	OFF	OFF
Commutation Failure	Yes	OFF	ON	ON	ON

Table 27: LED Indications of the PIC Starter for troubleshooting

4 DSPACE DS1103 PPC Controller Board

The DS1103 PPC controller board is inserted directly in the PC. The unsurpassed number of I/O interfaces makes the DS1103 PPC controller board an all-rounder for rapid control prototyping in such fields as:

- Electrical drives
- Positioning systems and pulse motors
- Robot control
- Automotive ECUs
- Servo hydraulics
- Active vibration reduction

DS1103 hardware consist of the following:

- PowerPC 604e with 400 MHz
- 2 Mbytes local SRAM
- 32-MByte or 128-MByte global DRAM
- 16 ADC channels, 16 bit
- ADC channels, 12 bit
- DAC channels, 14 bit
- Inductive RPM sensor interfaces (7 inputs)
- 32 digital I/O channels, programmable in 8-bit groups
- Serial interfaces
- CAN interface
- Three-phase PWM generation plus 4 single PMW outputs
- capture inputs
- 2 ADC units, each with 8 inputs, 10 bit
- 18-bit digital I/O

Figure 17: The dSPACE DS1103 PPC controller board

Figure 18: The ROBO-678 single board computer

Figure 19: DS1103 and ROBO-678 in the DAQCON Industrial Pentium III Computer

4.1 Installing the DS1103 in the PC

The DS1103 PPC Controller Board contains a Plug and Play circuit that can be used with ISA motherboards containing a Plug and Play BIOS. By default, the address switches on the DS1103 board are set to 000(0x0000), which enables the Plug and Play feature.

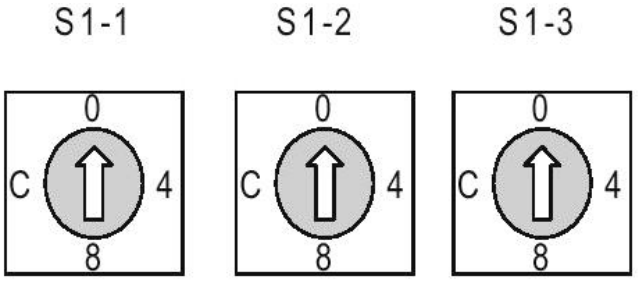


Figure 20: The DS1103 Address Switches

To install the DS1103 board in the host PC

1) Turn off the host PC and disconnect it from the mains.
2) Open the enclosure of the PC.
3) Select an empty full length 16-bit slot with two free brackets next to it. Remove the brackets that cover the openings on the rear side of the enclosure.
4) Insert the DS1103 and screw on the board's triple bracket. The connector next to the board is labeled P1, the second connector is labeled P2 and the third one P3.

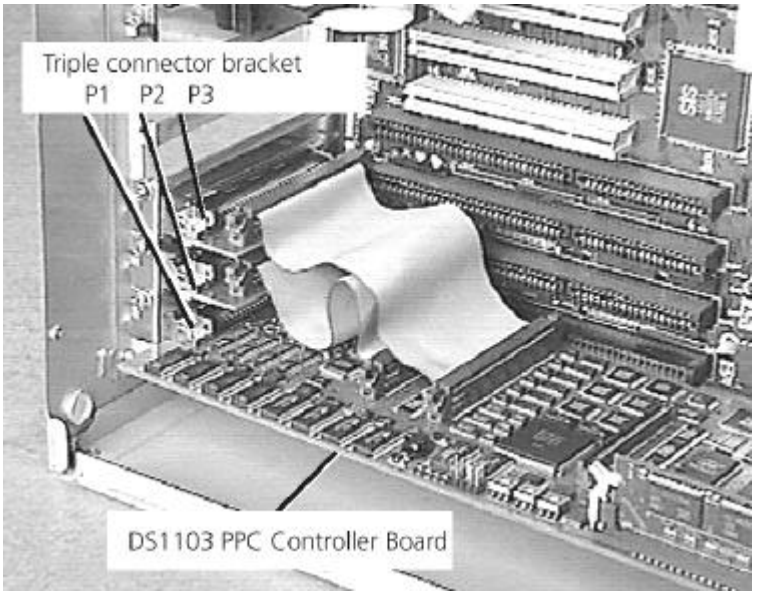


Figure 21: The DS1103 board in host PC

5) Close the enclosure, reconnect the PC to the mains and turn it on. The host PC should boot as usual.
6) If it does not, switch off the power supply immediately and check the insertion of the board.

4.2 Configuring the System

The dSPACE real-time hardware is managed by the Hardware Manager integrated in ControlDesk. The Hardware Manager is used to check and modify the configuration of the dSPACE system. After installing the dSPACE software, ControlDesk is available in the Windows Start menu and as an icon on the desktop.

To start ControlDesk

1) In the Windows Start menu, choose Programs – dSPACE Tools – ControlDesk.
2) In the Navigator, click the Hardware tab. The Hardware Navigator appears.

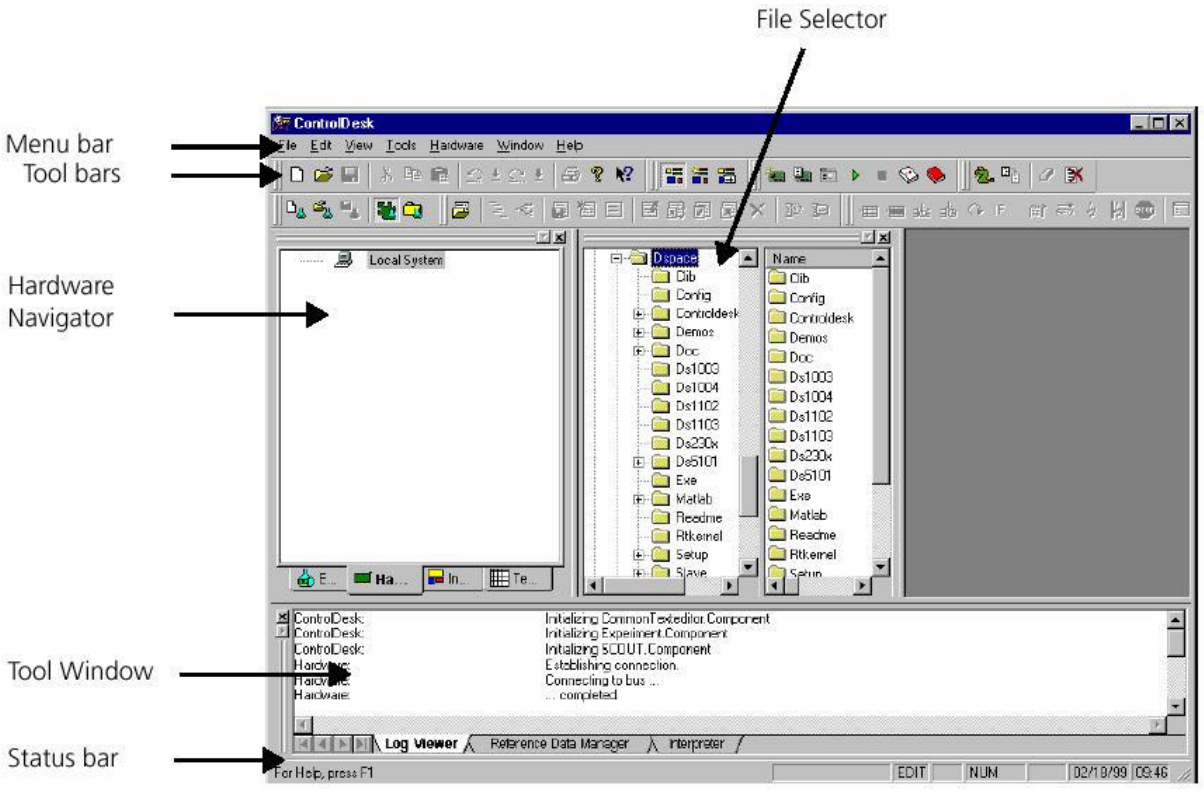


Figure 22: The ControlDesk Screen

If the Plug and Play feature has been used when installing the DS1103 PPC Controller Board, the board has been configured automatically. No further configuration is necessary. When starting the Hardware Navigator of ControlDesk, the DS1103 is displayed in the Navigator in the top left of the main window. The system is ready to run real-time applications on the board.

To view the board properties

1) In the Navigator, double-click the appropriate DS1103 board.
2) In the Controller Board Properties dialog box, check the individual tabs.

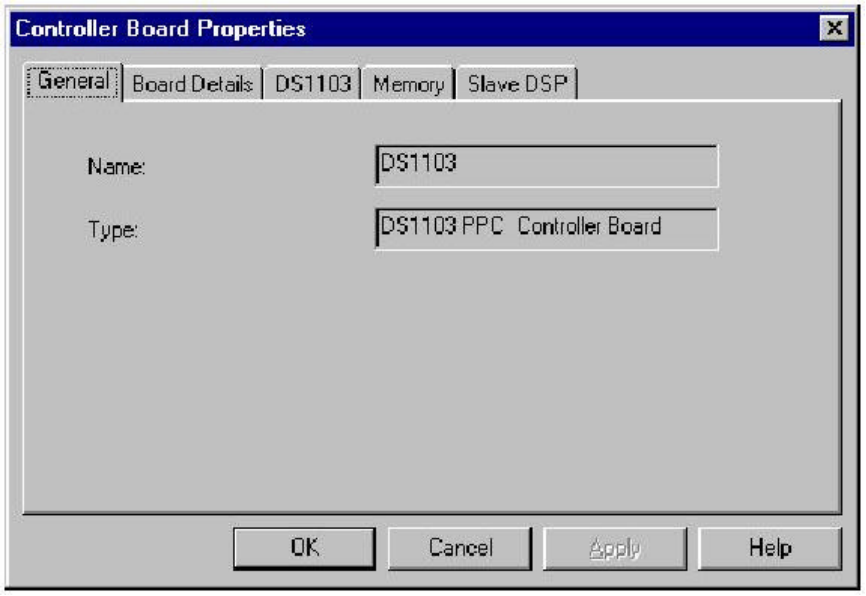


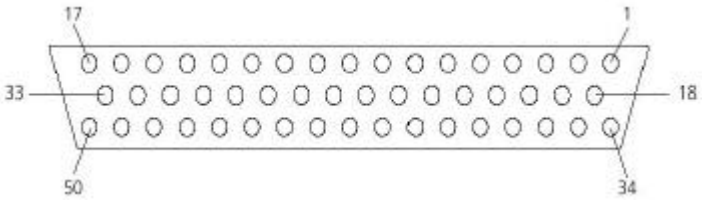
Figure 23: The DS1103 Controller Board Properties Dialog Box

4.3 Connector Pinouts of the DS1103

The connectors on the DS1103 PPC Controller Board are described below.

1) The **Analog Connector (P1)** is the 100-pin connector on the DS1103 board itself.
2) The **Digital Connector (P2)** is connected to the 100-pin connector on the bracket next to P1.
3) The **Incremental Encoder/Digital Connector (P3)** is connected to the 100-pin connector on the bracket next to P2.

Using the adapter cables coming with the board, these connectors can be linked to six 50-pin female SUB-D connectors (labeled P1A, P1B, P2A,...). The following figure shows the numbering used (viewed from the top of the female connectors).



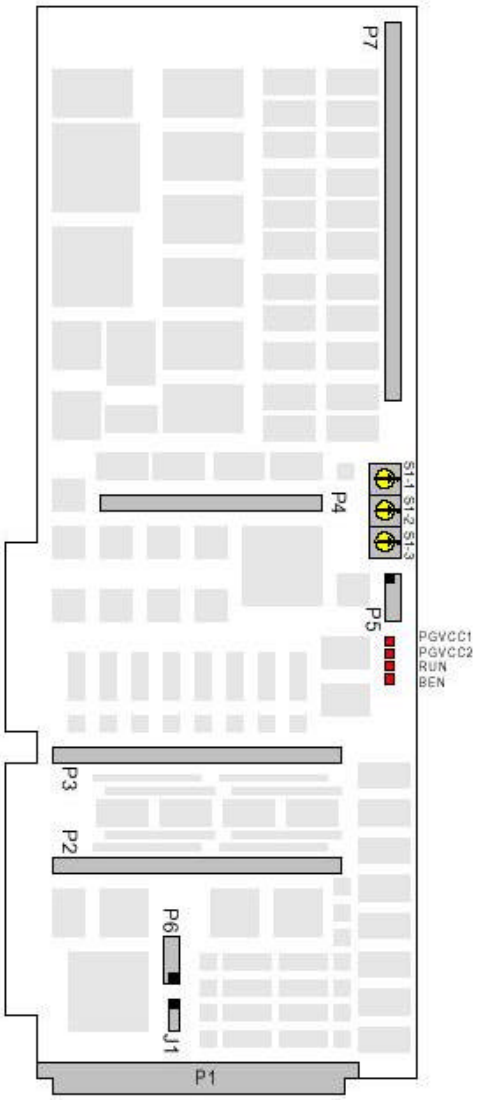


Figure 24: The SUB-D Connector and DS1103 board

4.3.1 Analog Connector (P1)

The following table shows the specifications of the signals sorted by the pin numbers of the 100-pin connector.

Analog Connector (P1) sorted by connector pin

Signal	Connector Pin	SUB-D Pin	Description [alternative function]	Voltage Range/ Output Current
GND	1	P1B 01		
GND	2	P1A 01		
ADCH1	3	P1B 34	16-bit ADC/4 µs	±10V
ADCH2	4	P1A 34	16-bit ADC/4 µs	±10V
GND	5	P1B 18		
GND	6	P1A 18		
ADCH3	7	P1B 02	16-bit ADC/4 µs	±10V
ADCH4	8	P1A 02	16-bit ADC/4 µs	±10V
GND	9	P1B 35		
GND	10	P1A 35		
ADCH5	11	P1B 19	16-bit ADC/4 µs	±10V
ADCH6	12	P1A 19	16-bit ADC/4 µs	±10V
GND	13	P1B 03		
GND	14	P1A 03		
ADCH7	15	P1B 36	16-bit ADC/4 µs	±10V
ADCH8	16	P1A 36	16-bit ADC/4 µs	±10V
GND	17	P1B 20		
GND	18	P1A 20		
ADCH9	19	P1B 04	16-bit ADC/4 µs	±10V
ADCH10	20	P1A 04	16-bit ADC/4 µs	±10V
GND	21	P1B 37		
GND	22	P1A 37		
ADCH11	23	P1B 21	16-bit ADC/4 µs	±10V
ADCH12	24	P1A 21	16-bit ADC/4 µs	±10V
GND	25	P1B 05		
GND	26	P1A 05		
ADCH13	27	P1B 38	16-bit ADC/4 µs	±10V
ADCH14	28	P1A 38	16-bit ADC/4 µs	±10V
GND	29	P1B 22		
GND	30	P1A 22		
ADCH15	31	P1B 06	16-bit ADC/4 µs	±10V
ADCH16	32	P1A 06	16-bit ADC/4 µs	±10V
GND	33	P1B 39		
GND	34	P1A 39		
ADCH17	35	P1B 23	12-bit ADC/0,8 µs	±10V

Analog Connector (P1) sorted by connector pin (Continued)				
Signal	Connector Pin	SUB-D Pin	Description [alternative function]	Voltage Range/ Output Current
ADCH18	36	P1A 23	12-bit ADC/0,8 µs	±10V
GND	37	P1B 07		
GND	38	P1A 07		
ADCH19	39	P1B 40	12-bit ADC/0,8 µs	±10V
ADCH20	40	P1A 40	12-bit ADC/0,8 µs	±10V
GND	41	P1B 24		
GND	42	P1A 24		
GND	43	P1B 08		
GND	44	P1A 08		
GND	45	P1B 41		
GND	46	P1A 41		
DACH1	47	P1B 25	14-bit DAC/6 µs	±10V/±5mA
DACH2	48	P1A 25	14-bit DAC/6 µs	±10V/±5mA
GND	49	P1B 09		
GND	50	P1A 09		
DACH3	51	P1B 42	14-bit DAC/6 µs	±10V/±5mA
DACH4	52	P1A 42	14-bit DAC/6 µs	±10V/±5mA
GND	53	P1B 26		
GND	54	P1A 26		
DACH5	55	P1B 10	14-bit DAC/6 µs	±10V/±5mA
DACH6	56	P1A 10	14-bit DAC/6 µs	±10V/±5mA
GND	57	P1B 43		
GND	58	P1A 43		
DACH7	59	P1B 27	14-bit DAC/6 µs	±10V/±5mA
DACH8	60	P1A 27	14-bit DAC/6 µs	±10V/±5mA
GND	61	P1B 11		
GND	62	P1A 11		
GND	63	P1B 44		
GND	64	P1A 44		
GND	65	P1B 28		
GND	66	P1A 28		
SADCH1	67	P1B 12	10-bit ADC/6 µs [digital I/O]	0-5V [TTL]/no [±7mA]
SADCH2	68	P1A 12	10-bit ADC/6 µs [digital I/O]	0-5V [TTL]/no [±7mA]
GND	69	P1B 45		
GND	70	P1A 45		
SADCH3	71	P1B 29	10-bit ADC/6 µs	0-5V
SADCH4	72	P1A 29	10-bit ADC/6 µs	0-5V
GND	73	P1B 13		
GND	74	P1A 13		
SADCH5	75	P1B 46	10-bit ADC/6 µs	0-5V
SADCH6	76	P1A 46	10-bit ADC/6 µs	0-5V
GND	77	P1B 30		
GND	78	P1A 30		
SADCH7	79	P1B 14	10-bit ADC/6 µs	0-5V
SADCH8	80	P1A 14	10-bit ADC/6 µs [digital I/O]	0-5V
GND	81	P1B 47		
GND	82	P1A 47		

Analog Connector (P1) sorted by connector pin (Continued)				
Signal	**Connector Pin**	**SUB-D Pin**	**Description [alternative function]**	**Voltage Range/ Output Current**
SADCH9	83	P1B 31	10-bit ADC/6 µs	0-5V [TTL]/no [±7mA]
SADCH10	84	P1A 31	10-bit ADC/6 µs [digital I/O]	0-5V [TTL]/no [±7mA]
GND	85	P1B 15		
GND	86	P1A 15		
SADCH11	87	P1B 48	10-bit ADC/6 µs	0-5V
SADCH12	88	P1A 48	10-bit ADC/6 µs	0-5V
GND	89	P1B 32		
GND	90	P1A 32		
SADCH13	91	P1B 16	10-bit ADC/6 µs	0-5V
SADCH14	92	P1A 16	10-bit ADC/6 µs	0-5V
GND	93	P1B 49		
GND	94	P1A 49		
SADCH15	95	P1B 33	10-bit ADC/6 µs	0-5V
SADCH16	96	P1A 33	10-bit ADC/6 µs	0-5V
GND	97	P1B 17		
GND	98	P1A 17		
SADCOSC	99	P1B 50	Digital I/O [SADCHx start of conversion input]	
GND	100	P1A 50		

Table 28: Analog Connector (P1)

4.3.2 Digital Connector (P2)

The following table shows the specifications of the signals sorted by the pin numbers of the 100-pin connector.

Digital Connector (P2) sorted by connector pin				
Signal	**Connector Pin**	**SUB-D Pin**	**Description [alternative function]**	**Voltage Range/ Output Current**
GND	1	P2B 01		
GND	2	P2A 01		
GND	3	P2B 34		
GND	4	P2A 34		
IO0	5	P2B 18	Digital I/O	TTL/±10mA
IO1	6	P2A 18	Digital I/O	TTL/±10mA
IO2	7	P2B 02	Digital I/O	TTL/±10mA
IO3	8	P2A 02	Digital I/O	TTL/±10mA
GND	9	P2B 35		
GND	10	P2A 35		
IO4	11	P2B 19	Digital I/O	TTL/±10mA
IO5	12	P2A 19	Digital I/O	TTL/±10mA
IO6	13	P2B 03	Digital I/O	TTL/±10mA
IO7	14	P2A 03	Digital I/O	TTL/±10mA
GND	15	P2B 36		
GND	16	P2A 36		
IO8	17	P2B 20	Digital I/O	TTL/±10mA
IO9	18	P2A 20	Digital I/O	TTL/±10mA
IO10	19	P2B 04	Digital I/O	TTL/±10mA
IO11	20	P2A 04	Digital I/O	TTL/±10mA
GND	21	P2B 37		
GND	22	P2A 37		
IO12	23	P2B 21	Digital I/O	TTL/±10mA
IO13	24	P2A 21	Digital I/O	TTL/±10mA
IO14	25	P2B 05	Digital I/O	TTL/±10mA
IO15	26	P2A 05	Digital I/O	TTL/±10mA
GND	27	P2B 38		
GND	28	P2A 38		
IO16	29	P2B 22	Digital I/O	TTL/±10mA
IO17	30	P2A 22	Digital I/O	TTL/±10mA
IO18	31	P2B 06	Digital I/O	TTL/±10mA
IO19	32	P2A 06	Digital I/O	TTL/±10mA
GND	33	P2B 39		
GND	34	P2A 39		
IO20	35	P2B 23	Digital I/O	TTL/±10mA

Digital Connector (P2) sorted by connector pin (Continued)

Signal	Connector Pin	SUB-D Pin	Description [alternative function]	Voltage Range/ Output Current
IO21	36	P2A 23	Digital I/O	TTL/±10mA
IO22	37	P2B 07	Digital I/O	TTL/±10mA
IO23	38	P2A 07	Digital I/O	TTL/±10mA
GND	39	P2B 40		
GND	40	P2A 40		
IO24	41	P2B 24	Digital I/O	TTL/±10mA
IO25	42	P2A 24	Digital I/O	TTL/±10mA
IO26	43	P2B 08	Digital I/O	TTL/±10mA
IO27	44	P2A 08	Digital I/O	TTL/±10mA
GND	45	P2B 41		
GND	46	P2A 41		
IO28	47	P2B 25	Digital I/O	TTL/±10mA
IO29	48	P2A 25	Digital I/O	TTL/±10mA
IO30	49	P2B 09	Digital I/O	TTL/±10mA
IO31	50	P2A 09	Digital I/O	TTL/±10mA
GND	51	P2B 42		
GND	52	P2A 42		
STINT1	53	P2B 26	Slave Interrupt Input	TTL
STINT2	54	P2A 26	Slave Interrupt Input [digital I/O]	TTL [TTL]/no [±13mA]
STMRDIR	55	P2B 10	Direction input signal for timers [digital I/O]	TTL [TTL]/no [±13mA]
STMRCLK	56	P2A 10	External Clock input for timers [digital I/O]	TTL [TTL]/no [±13mA]
GND	57	P2B 43		
GND	58	P2A 43		
ST1PWM	59	P2B 27	Simple Compare/PWMx Output [digital I/O]	TTL [TTL]/±13mA [±13mA]
ST2PWM	60	P2A 27	Simple Compare/PWMx Output [digital I/O]	TTL [TTL]/±13mA [±13mA]
ST3PWM	61	P2B 11	Simple Compare/PWMx Output [digital I/O]	TTL [TTL]/±13mA [±13mA]
SPDPINT	62	P2A 11	Maskable power-drive protection input	TTL
GND	63	P2B 44		
GND	64	P2A 44		
SPWM1	65	P2B 28	Compare units compare [PWM outputs]	TTL [TTL]/no [±13mA]
SPWM2	66	P2A 28	Compare units compare [PWM outputs]	TTL [TTL]/no [±13mA]
SPWM3	67	P2B 12	Compare units compare [PWM outputs]	TTL [TTL]/no [±13mA]
SPWM4	68	P2A 12	Compare units compare [PWM outputs]	TTL [TTL]/no [±13 mA]
SPWM5	69	P2B 45	Compare units compare [PWM outputs]	TTL [TTL]/no [±13 mA]
SPWM6	70	P2A 45	Compare units compare [PWM outputs]	TTL [TTL]/no [±13 mA]
SPWM7	71	P2B 29	Simple Compare [PWM outputs or dig. I/O]	TTL [TTL]/no [±13 mA]
SPWM8	72	P2A 29	Simple Compare [PWM outputs or dig. I/O]	TTL [TTL]/no [±13 mA]
SPWM9	73	P2B 13	Simple Compare [PWM outputs or dig. I/O]	TTL [TTL]/no [±13 mA]
GND	74	P2A 13		
GND	75	P2B 46		
GND	76	P2A 46		
SCAP1	77	P2B 30	Capture input [digital I/O]	TTL [TTL]/no [±13 mA]
SCAP2	78	P2A 30	Capture input [digital I/O]	TTL [TTL]/no [±13 mA]
SCAP3	79	P2B 14	Capture input [digital I/O]	TTL [TTL]/no [±13 mA]
SCAP4	80	P2A 14	Capture input [digital I/O]	TTL [TTL]/no [±13 mA]
GND	81	P2B 47		
GND	82	P2A 47		

Digital Connector (P2) sorted by connector pin (Continued)				
Signal	**Connector Pin**	**SUB-D Pin**	**Description [alternative function]**	**Voltage Range/ Output Current**
SXF	83	P2B 31	External flag output [digital I/O]	TTL [TTL]/±13mA [±13mA]
SBIO	84	P2A 31	Branch Control input [digital I/O]	TTL [TTL]/no [±13mA]
SCLK	85	P2B 15	SPI Clock [digital I/O]	TTL [TTL]/±13mA [±13mA]
SSTE	86	P2A 15	SPI slave transmit enable [digital I/O]	TTL [TTL]/±13mA [±13mA]
SSIMO	87	P2B 48	SPI slave in, master out [digital I/O]	TTL [TTL]/±13mA [±13mA]
SSOMI	88	P2A 48	SPI slave out, master in [digital I/O]	TTL [TTL]/±13mA [±13mA]
GND	89	P2B 32		
GND	90	P2A 32		
/INT0	91	P2B 16	External Interrupt inputs	TTL
/INT1	92	P2A 16	External Interrupt inputs	TTL
/INT2	93	P2B 49	External Interrupt inputs	TTL
/INT3	94	P2A 49	External Interrupt inputs	TTL
VCC1	95	P2B 33	PC 5V multifuse protected power supply	5 V ±10%/500 mA
VCC1	96	P2A 33	PC 5V multifuse protected power supply	5 V ±10%/500 mA
VCC1	97	P2B 17	PC 5V multifuse protected power supply	5 V ±10%/500 mA
VCC1	98	P2A 17	PC 5V multifuse protected power supply	5 V ±10%/500 mA
GND	99	P2B 50		
GND	100	P2A 50		

Table 29: Digital Connector (P2)

4.3.3 Incremental Encoder/Digital Connector (P3)

The following table shows the specifications of the signals sorted by the pin numbers of the 100-pin connector.

Incremental Encoder/Digital Connector (P3) sorted by connector pin

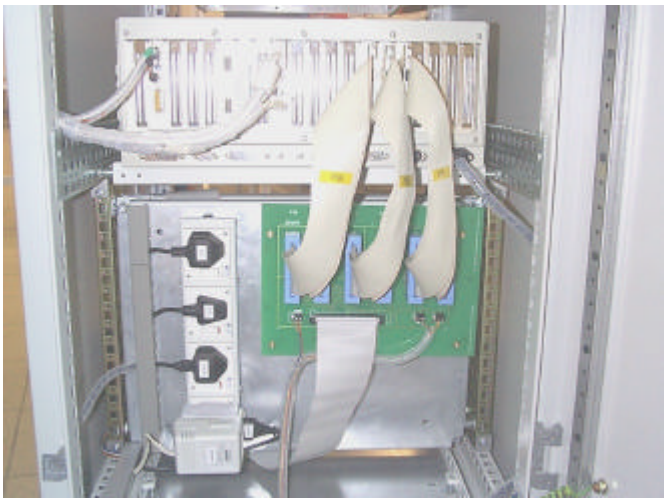
Signal	Connector Pin	SUB-D Pin	Description [alternative function]	Voltage Range/ Output Current
GND	1	P3B 01		
GND	2	P3A 01		
TXD	3	P3B 34	RS-232/RS-422 transceive	RS-232/RS-422
/TXD	4	P3A 34	RS-232/RS-422 transceive	RS-232/RS-422
RXD	5	P3B 18	RS-232/RS-422 receive	RS-232/RS-422
/RXD	6	P3A 18	RS-232/RS-422 receive	RS-232/RS-422
RTS	7	P3B 02	RS-232/RS-422 request to send	RS-232/RS-422
/RTS	8	P3A 02	RS-232/RS-422 request to send	RS-232/RS-422
CTS	9	P3B 35	RS-232/RS-422 clear to send	RS-232/RS-422
/CTS	10	P3A 35	RS-232/RS-422 clear to send	RS-232/RS-422
/RI	11	P3B 19	RS-232/RS-422 ring indicator	RS-232/RS-422
GND	12	P3A 19		
STXD	13	P3B 03	RS-232/RS-422 transceive (Slave DSP)	RS-232/RS-422
/STXD	14	P3A 03	RS-232/RS-422 transceive (Slave DSP)	RS-232/RS-422
SRXD	15	P3B 36	RS-232/RS-422 receive (Slave DSP)	RS-232/RS-422
/SRXD	16	P3A 36	RS-232/RS-422 receive (Slave DSP)	RS-232/RS-422
	17	P3B 20	reserved for future expansion	
	18	P3A 20	reserved for future expansion	
	19	P3B 04	reserved for future expansion	
	20	P3A 04	reserved for future expansion	
	21	P3B 37	reserved for future expansion	
	22	P3A 37	reserved for future expansion	
	23	P3B 21	reserved for future expansion	
	24	P3A 21	reserved for future expansion	
	25	P3B 05	reserved for future expansion	
	26	P3A 05	reserved for future expansion	
GND	27	P3B 38		
GND	28	P3A 38		
PHI0(7)	29	P3B 22	Analog Incremental Enc. Interface Input 0°	1 Vpp or 11 µApp
/PHI0(7)	30	P3A 22	Analog Incremental Enc. Interface Input 0°	1 Vpp or 11 µApp
PHI90(7)	31	P3B 06	Analog Incremental Enc. Interface Input 90°	1 Vpp or 11 µApp
/PHI90(7)	32	P3A 06	Analog Incremental Enc. Interface Input 90°	1 Vpp or 11 µApp
IDX(7)	33	P3B 39	Analog Incremental Enc. Interface Input Index	1 Vpp or 11 µApp
/IDX(7)	34	P3A 39	Analog Incremental Enc. Interface Input Index	1 Vpp or 11 µApp
GND	35	P3B 23		

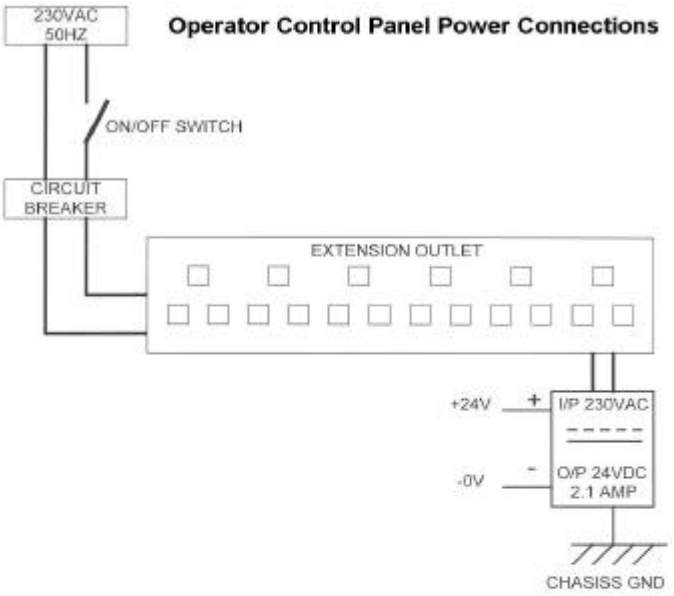
Incremental Encoder/Digital Connector (P3) sorted by connector pin (Continued)				
Signal	Connector Pin	SUB-D Pin	Description [alternative function]	Voltage Range/ Output Current
GND	36	P3A 23		
PHI0(6)	37	P3B 07	Digital Incremental Enc. Interface Input 0°	TTL or RS-422
/PHI0(6)	38	P3A 07	Digital Incremental Enc. Interface Input 0°	TTL or RS-422
PHI90(6)	39	P3B 40	Digital Incremental Enc. Interface Input 90°	TTL or RS-422
/PHI90(6)	40	P3A 40	Digital Incremental Enc. Interface Input 90°	TTL or RS-422
IDX(6)	41	P3B 24	Digital Incremental Enc. Interface Input Index	TTL or RS-422
/IDX(6)	42	P3A 24	Digital Incremental Enc. Interface Input Index	TTL or RS-422
GND	43	P3B 08		
GND	44	P3A 08		
PHI0(1)	45	P3B 41	Digital Incremental Enc. Interface Input 0°	TTL or RS-422
/PHI0(1)	46	P3A 41	Digital Incremental Enc. Interface Input 0°	TTL or RS-422
PHI90(1)	47	P3B 25	Digital Incremental Enc. Interface Input 90°	TTL or RS-422
/PHI90(1)	48	P3A 25	Digital Incremental Enc. Interface Input 90°	TTL or RS-422
IDX(1)	49	P3B 09	Digital Incremental Enc. Interface Input Index	TTL or RS-422
/IDX(1)	50	P3A 09	Digital Incremental Enc. Interface Input Index	TTL or RS-422
GND	51	P3B 42		
GND	52	P3A 42		
PHI0(2)	53	P3B 26	Digital Incremental Enc. Interface Input 0°	TTL or RS-422
/PHI0(2)	54	P3A 26	Digital Incremental Enc. Interface Input 0°	TTL or RS-422
PHI90(2)	55	P3B 10	Digital Incremental Enc. Interface Input 90°	TTL or RS-422
/PHI90(2)	56	P3A 10	Digital Incremental Enc. Interface Input 90°	TTL or RS-422
IDX(2)	57	P3B 43	Digital Incremental Enc. Interface Input Index	TTL or RS-422
/IDX(2)	58	P3A 43	Digital Incremental Enc. Interface Input Index	TTL or RS-422
GND	59	P3B 27		
GND	60	P3A 27		
PHI0(3)	61	P3B 11	Digital Incremental Enc. Interface Input 0°	TTL or RS-422
/PHI0(3)	62	P3A 11	Digital Incremental Enc. Interface Input 0°	TTL or RS-422
PHI90(3)	63	P3B 44	Digital Incremental Enc. Interface Input 90°	TTL or RS-422
/PHI90(3)	64	P3A 44	Digital Incremental Enc. Interface Input 90°	TTL or RS-422
IDX(3)	65	P3B 28	Digital Incremental Enc. Interface Input Index	TTL or RS-422
/IDX(3)	66	P3A 28	Digital Incremental Enc. Interface Input Index	TTL or RS-422
GND	67	P3B 12		
GND	68	P3A 12		
PHI0(4)	69	P3B 45	Digital Incremental Enc. Interface Input 0°	TTL or RS-422
/PHI0(4)	70	P3A 45	Digital Incremental Enc. Interface Input 0°	TTL or RS-422
PHI90(4)	71	P3B 29	Digital Incremental Enc. Interface Input 90°	TTL or RS-422
/PHI90(4)	72	P3A 29	Digital Incremental Enc. Interface Input 90°	TTL or RS-422
IDX(4)	73	P3B 13	Digital Incremental Enc. Interface Input Index	TTL or RS-422
/IDX(4)	74	P3A 13	Digital Incremental Enc. Interface Input Index	TTL or RS-422
GND	75	P3B 46		
GND	76	P3A 46		
PHI0(5)	77	P3B 30	Digital Incremental Enc. Interface Input 0°	TTL or RS-422
/PHI0(5)	78	P3A 30	Digital Incremental Enc. Interface Input 0°	TTL or RS-422
PHI90(5)	79	P3B 14	Digital Incremental Enc. Interface Input 90°	TTL or RS-422
/PHI90(5)	80	P3A 14	Digital Incremental Enc. Interface Input 90°	TTL or RS-422
IDX(5)	81	P3B 47	Digital Incremental Enc. Interface Input Index	TTL or RS-422
/IDX(5)	82	P3A 47	Digital Incremental Enc. Interface Input Index	TTL or RS-422

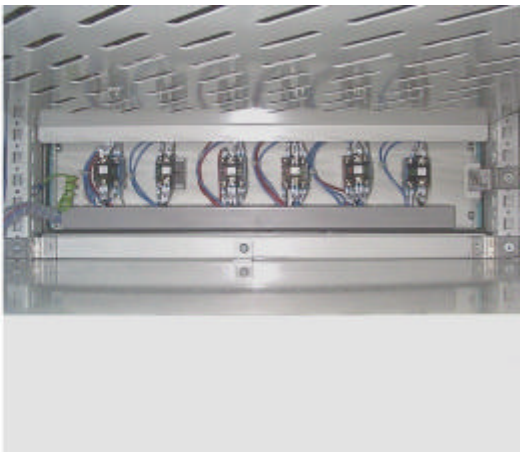
Incremental Encoder/Digital Connector (P3) sorted by connector pin (Continued)				
Signal	**Connector Pin**	**SUB-D Pin**	**Description [alternative function]**	**Voltage Range/ Output Current**
GND	83	P3A 31		
GND	84	P3B 31		
CANL	85	P3B 15	CAN Bus Interface Low	ISO11898, 24 V
GND	86	P3A 15		
CANH	87	P3B 48	CAN Bus Interface High	ISO11898, 24 V
GND	88	P3A 48		
GND	89	P3B 32		
GND	90	P3A 32		
VCC2	91	P3B 16	PC 5V multifuse protected power supply	5 V ±10%/500 mA
VCC2	92	P3A 16	PC 5V multifuse protected power supply	5 V ±10%/500 mA
VCC2	93	P3B 49	PC 5V multifuse protected power supply	5 V ±10%/500 mA
VCC2	94	P3A 49	PC 5V multifuse protected power supply	5 V ±10%/500 mA
VCC3	95	P3B 33	PC 5V multifuse protected power supply	5 V ±10%/500 mA
VCC3	96	P3A 33	PC 5V multifuse protected power supply	5 V ±10%/500 mA
VCC3	97	P3B 17	PC 5V multifuse protected power supply	5 V ±10%/500 mA
VCC3	98	P3A 17	PC 5V multifuse protected power supply	5 V ±10%/500 mA
GND	99	P3B 50		
GND	100	P3A 50		

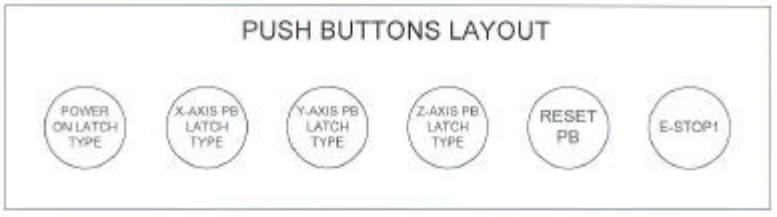
Table 30: Incremental Encoder/Digital Connector (P3)

5 Operator Control Panel Ladder Diagrams

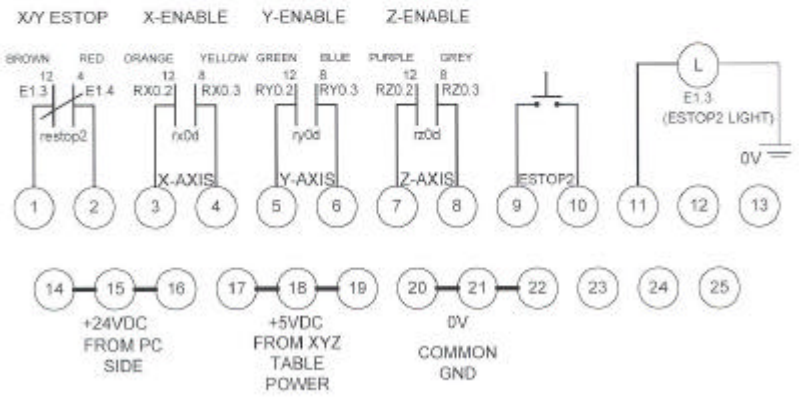




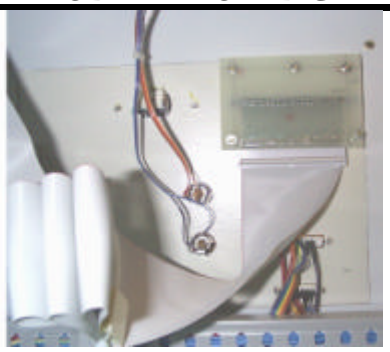




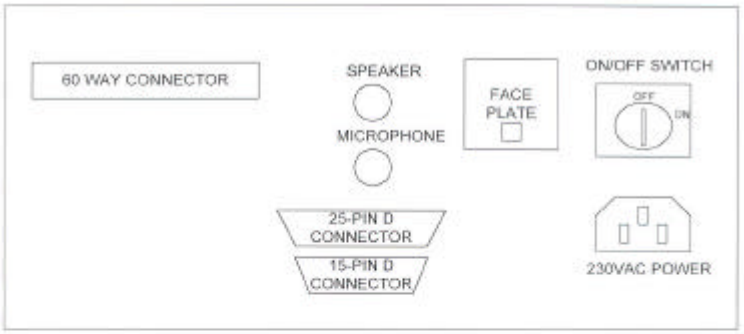
Operator Control Panel

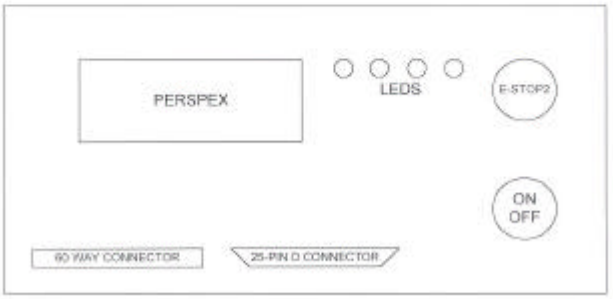


25-PIN D CONNECTOR LAYOUT

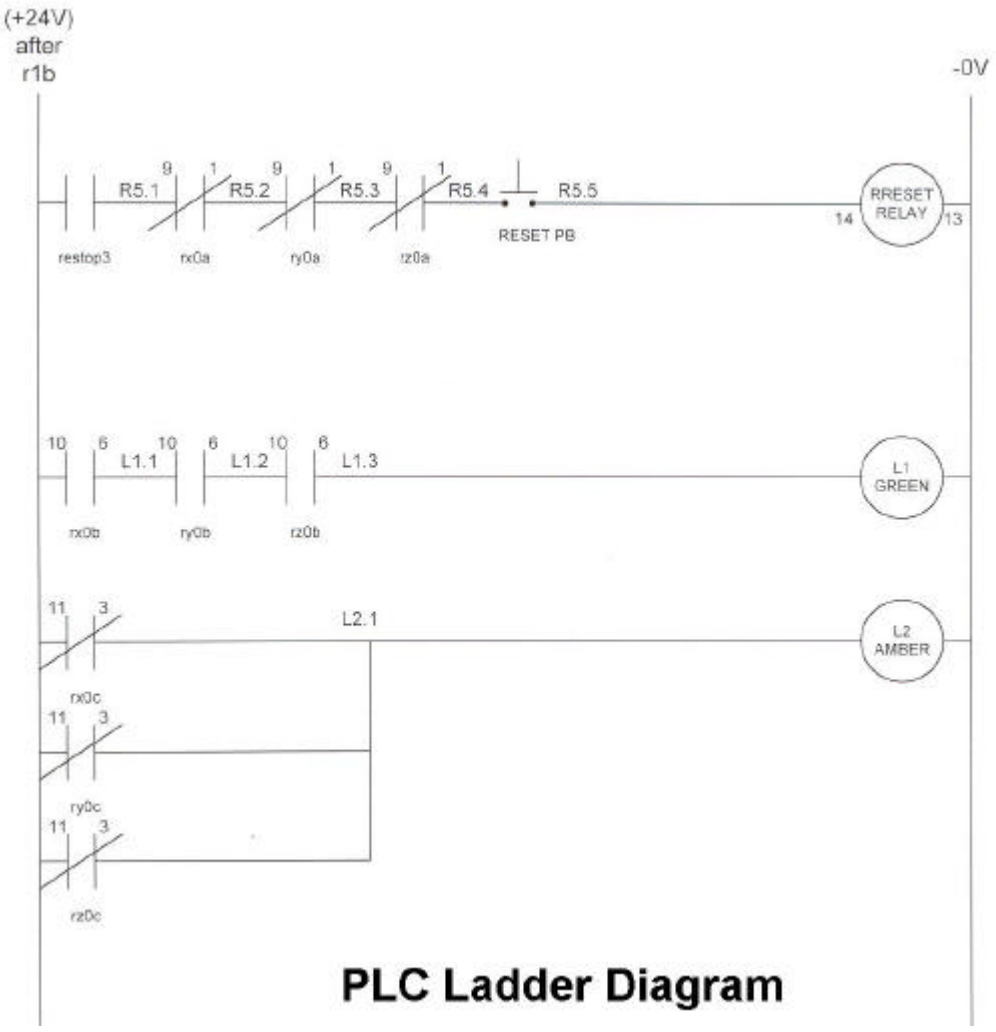


RACK MOUNTING (aluminium 300x250x3 mm)

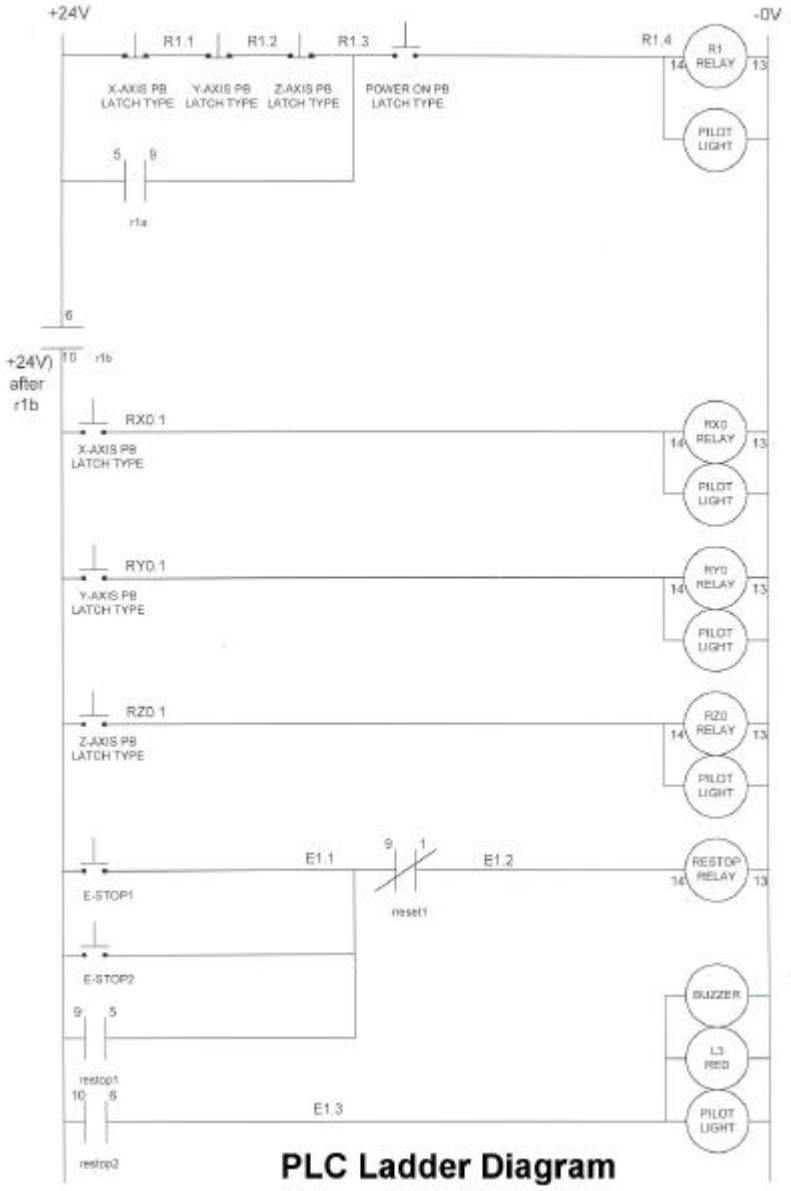




XYZ PANEL LAYOUT



PLC Ladder Diagram

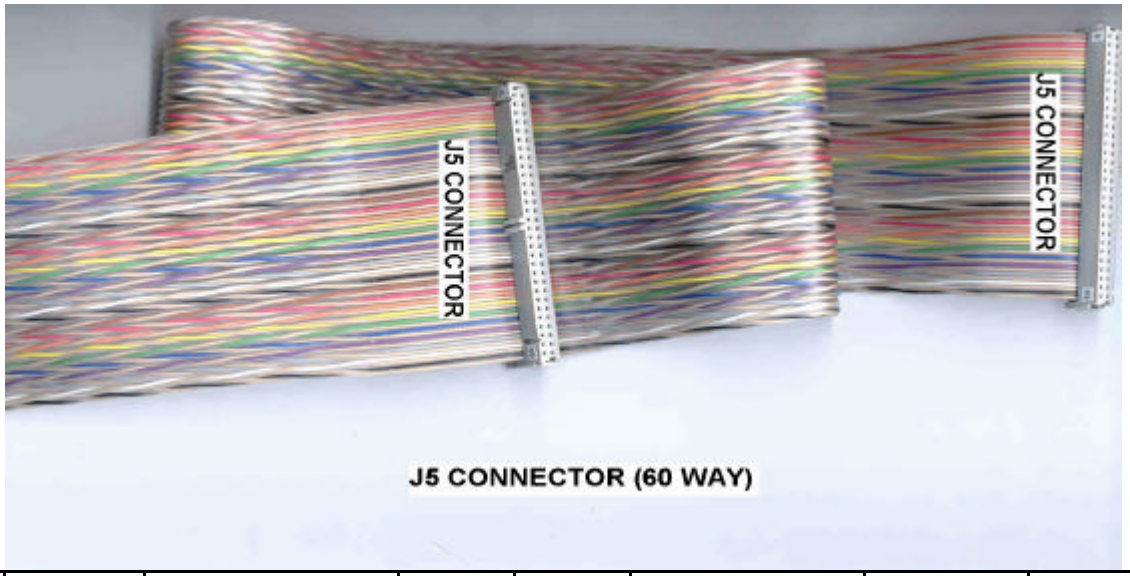


PLC Ladder Diagram

6 Troubleshooting Guide

7-segment display	Status	Action
d.	Disable	Bridge is disable (all the switches are "off"), no fault.
0.	Enable	All OK (amplifier is ready).
1.	Under voltage	Bus voltage is too low.
2.	Over voltage	Bus voltage is too high.
3.	SVP	Internal power supply problem.
4.	Shunt	The Shunt is operating.
5.	Short	Phases are shorted to each other or to the ground. Ishort = 3 × Ipeak
6.	Temperature	Amplifier temperature is too high.
7.	Feedback	Feedback loss.
L.	FLS	Forward switch is active according to the defined logic (IL[3]).
r.	RLS	Reverse switch is active according to the defined logic (IL[4]).
b.	FLS&RLS	Both switch are active together.
S.	Over speed	Speed exceeded high or low limitation (HL[2], LL[2]).
c.	IC	Continuous current limit is active.
P.	IP	Peak current limit is active.
C.	Over current	Current exceeded peak current limitation.
F.	Undeclared fault	Fault, which is not under the declaration of the LED. May be detected with MF command.

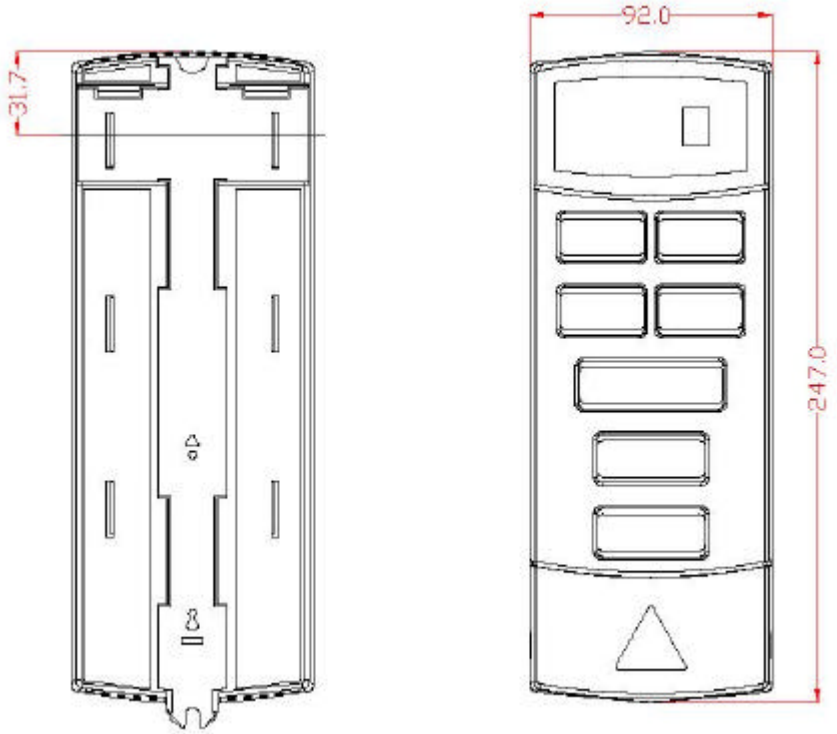
Appendix 1: Measured Voltages of J5 Connector



DS1103 Conn Pin No	SUB-D Conn Pin No	Descriptions	Connect To	J5 Conn Pin No	Descriptions	Measured Values	Colour of J5 Cables
NC	NC	NC		1	+5VFU	NC	Dark brown (from computer)
GND	GND	GND		2	Common	0V	Light brown (from computer)
P2-6	P2A-18	Digital I/O (out)		3	X_EN	0.046V	Red
NC	NC	NC		4	X_FLT	NC	Light brown
P1-48	P1A-25	14-bit DAC		5	X_Command0	-0.023V	Orange
GND	GND	GND		6	X_Command1	0V	Light brown
P2-29	P2B-22	Digital I/O		7	X_RL	-0.028V	Yellow
P2-30	P2A-22	Digital I/O		8	X_LL	-0.028V	Light brown
P3-41	P3B-24	Digital IE Index		9	X_CH1I+	-0.021V	Green
P3-42	P3A-24	Digital IE Index		10	X_CH1I-	0.068V	Light brown
P3-37	P3B-7	Digital IE 0°		11	X_CH1A+	3.856V	Blue
P3-38	P3A-7	Digital IE 0°		12	X_CH1A-	-0.017V	Light brown
P3-39	P3B-40	Digital IE 90°		13	X_CH1B+	-0.013V	Purple
P3-40	P3A-40	Digital IE 90°		14	X_CH1B-	4.065V	Light brown
P2-5	P2B-18	Digital I/O (out)		15	Y_EN	0.046V	Grey
NC	NC	NC		16	Y_FLT	NC	Light brown
P1-47	P1B-25	14-bit DAC		17	Y_Command0	-0.023V	White
GND	GND	GND		18	Y_Command1	0V	Light brown
P2-31	P2B-6	Digital I/O		19	Y_RL	-0.028V	Black
P2-32	P2A-6	Digital I/O		20	Y_LL	-0.028V	Light brown
P3-49	P3B-9	Digital IE Index		21	Y_CH1I+	-0.018V	Dark brown
P3-50	P3A-9	Digital IE Index		22	Y_CH1I-	3.825V	Light brown
P3-45	P3B-41	Digital IE 0°		23	Y_CH1A+	30853V	Red

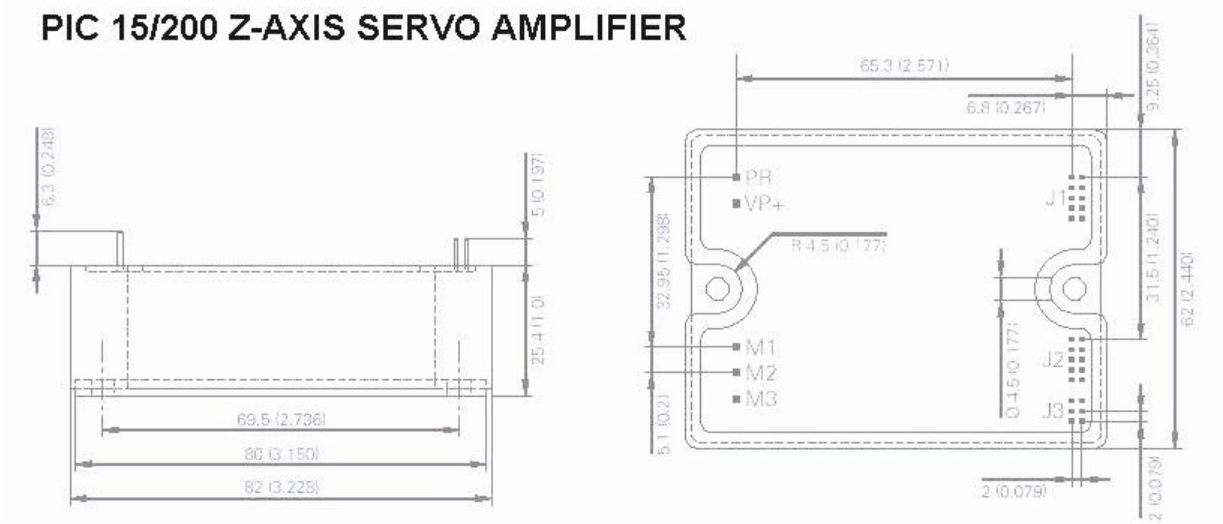
P3-46	P3A-41	Digital IE 0°		24	Y_CH1A-	-0.021V	Light brown
P3-47	P3B-25	Digital IE 90°		25	Y_CH1B+	3.847V	Orange
P3-48	P3A-25	Digital IE 90°		26	Y_CH1B-	-0.021V	Light brown
GND	GND	GND		27	RTNF	0V	Yellow (from driver)
GND	GND	GND		28	RTNF	0V	Light brown (from driver)
5V	5V	5V		29	5VF	4.9V	Green (from driver)
5V	5V	5V		30	5VF	4.9V	Light brown (from driver)
NC	NC	NC		31	+12VF	NC	Blue (from driver)
NC	NC	NC		32	-12VF	NC	Light brown (from driver)
P2-7	P2B-2	Digital I/O (out)		33	Z_EN	4.94V	Purple (Not connected)
NC	NC	NC		34	Z_FLT	NC	Light brown
P1-51	P1B-42	14-bit DAC		35	Z_Command0	-0.022V	Grey
GND	GND	GND		36	Z_Command1	0V	Light brown
P2-35	P2B-23	Digital I/O		37	Z_RL	-0.028V	White
P2-36	P2A-23	Digital I/O		38	Z_LL	-0.028V	Light brown
P3-57	P3B-43	Digital IE Index		39	Z_CH1I+	0.145V	Black
P3-58	P3A-43	Digital IE Index		40	Z_CH1I-	3.436V	Light brown
P3-53	P3B-26	Digital IE 0°		41	Z_CH1A+	3.462V	Dark brown
P3-54	P3A-26	Digital IE 0°		42	Z_CH1A-	0.144V	Light brown
P3-55	P3B-10	Digital IE 90°		43	Z_CH1B+	-0.014V	Red
P3-56	P3A-10	Digital IE 90°		44	Z_CH1B-	0.044V	Light brown
NC	NC	NC		45	T_EN	NC	Orange
NC	NC	NC		46	T_FLT	NC	Light brown
NC	NC	NC		47	T_Command0	NC	Yellow
GND	GND	GND		48	T_Command1	0V	Light brown (All gnd signals connect together)
NC	NC	NC		49	T_RL	NC	Green
NC	NC	NC		50	T_LL	NC	Light brown
NC	NC	NC		51	T_CH1I+	NC	Blue
NC	NC	NC		52	T_CH1I-	NC	Light brown
NC	NC	NC		53	T_CH1A+	NC	Purple
NC	NC	NC		54	T_CH1A-	NC	Light brown
NC	NC	NC		55	T_CH1B+	NC	Grey
NC	NC	NC		56	T_CH1B-	NC	Light brown
NC	NC	NC		57	ES	NC	White
NC	NC	NC		58	A_OUT	NC	Light brown
NC	NC	NC		59	+5VFU	NC	Black
GND	GND	GND		60	GND	0V	Light brown

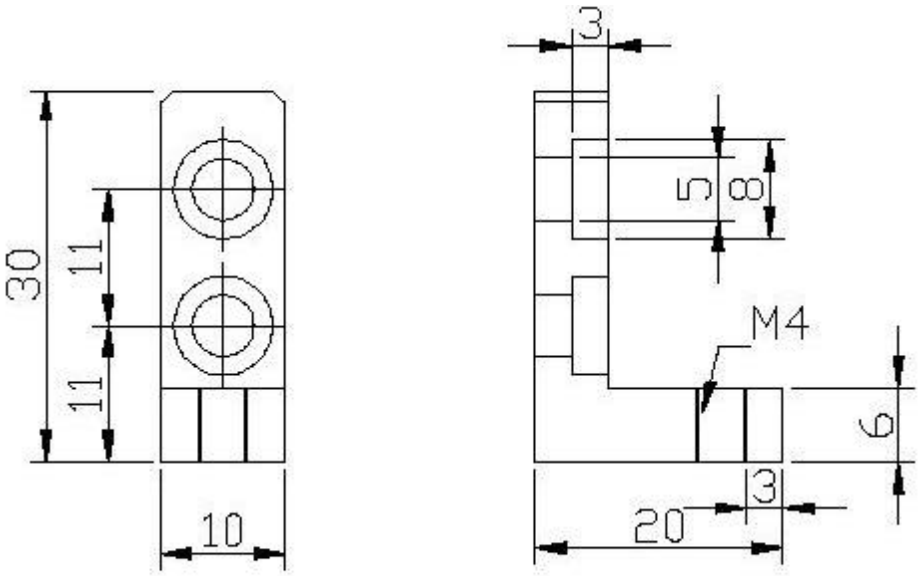
Appendix 2: Dimensional Drawings



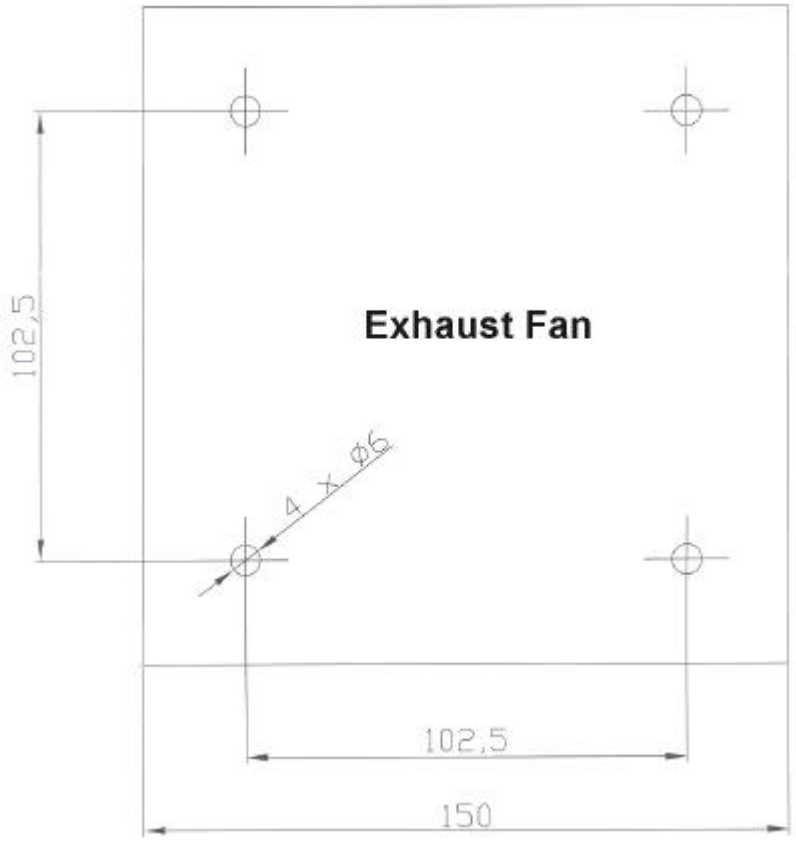
Elmo SAX 5/230 digital driver

PIC 15/200 Z-AXIS SERVO AMPLIFIER

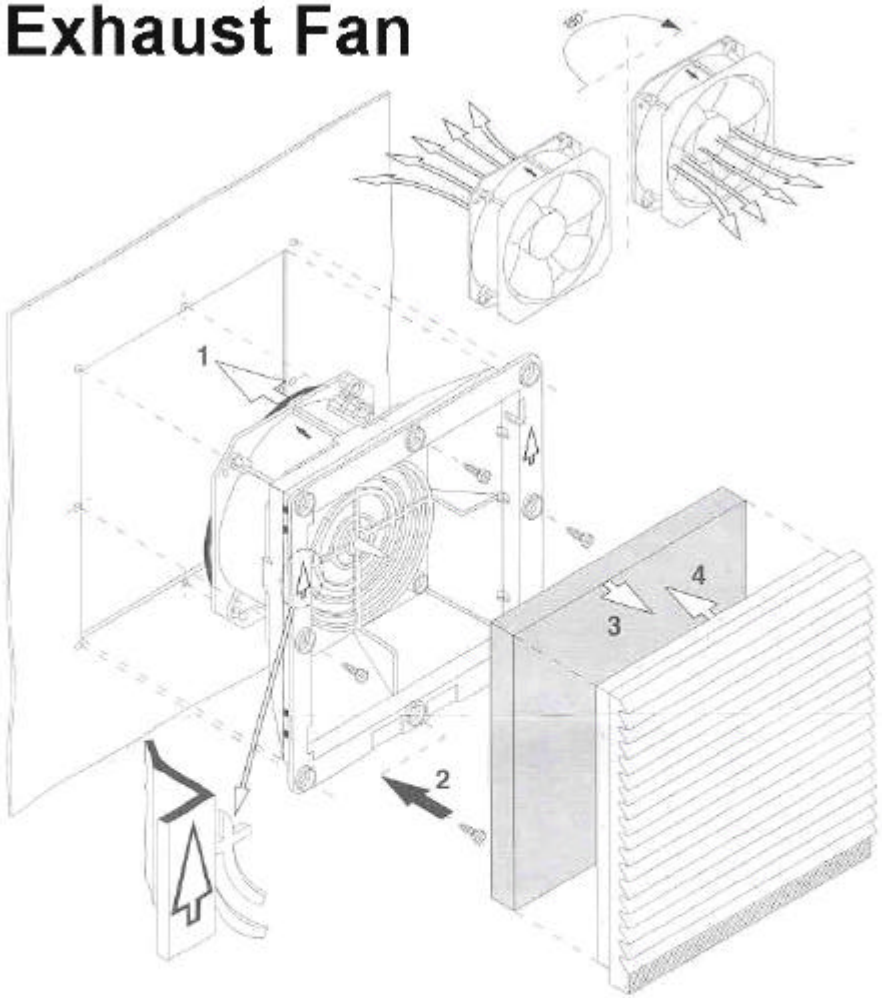


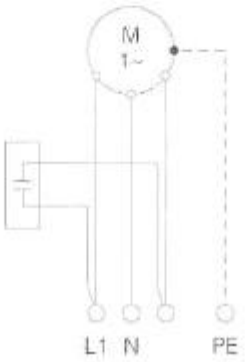


Z-axis L bracket (stopper)

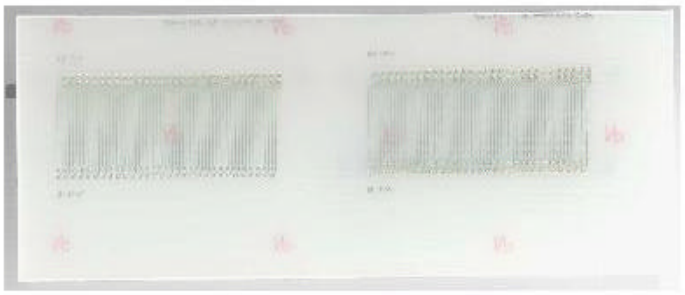

Exhaust Fan
102,5
4 x ϕ6
102,5
150

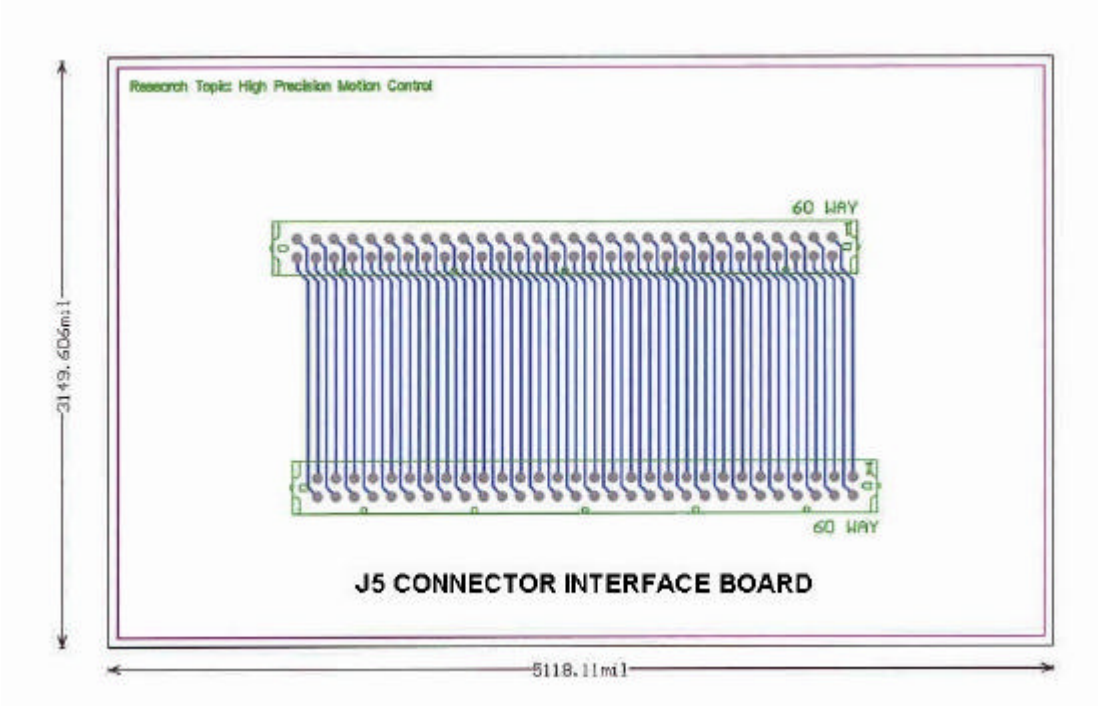
Exhaust Fan



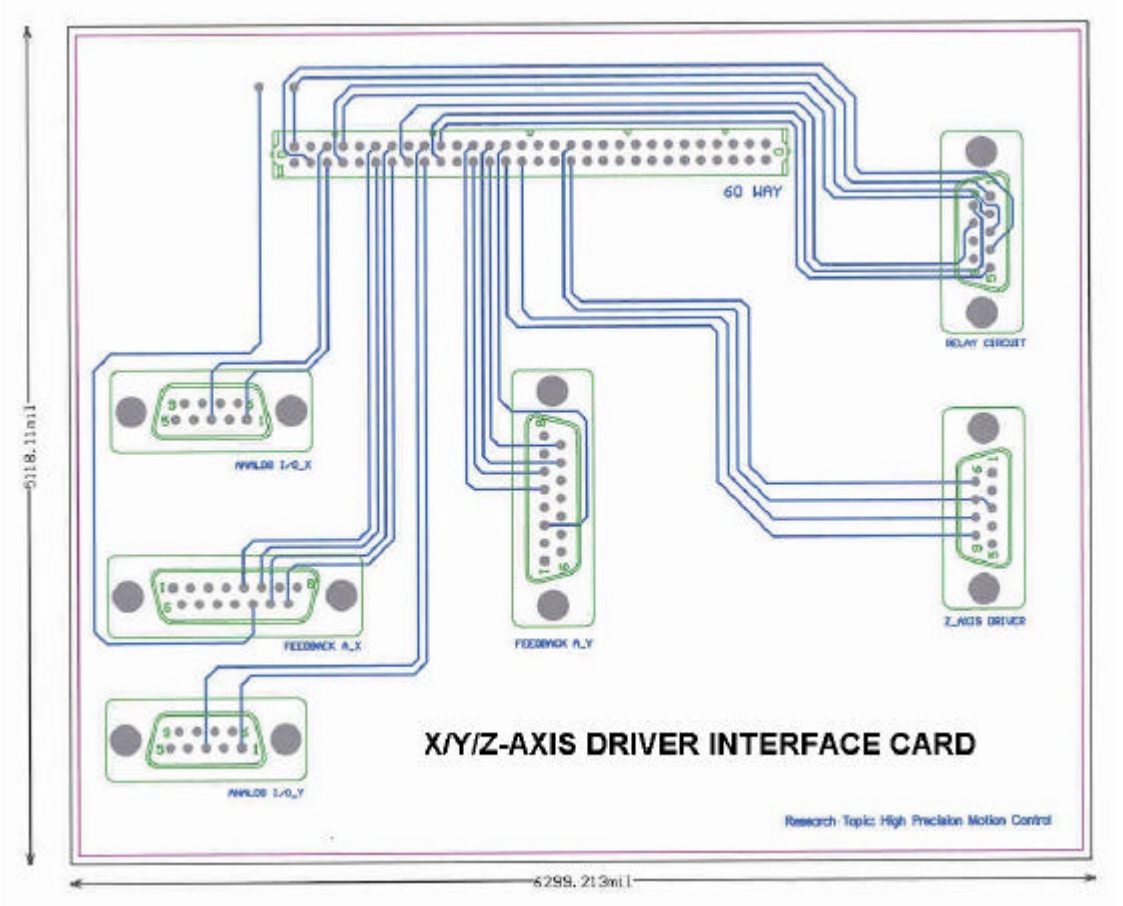


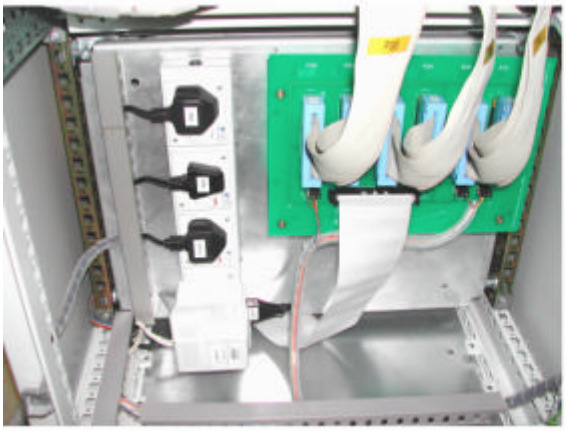
Appendix 3: PCB Schematic Diagrams

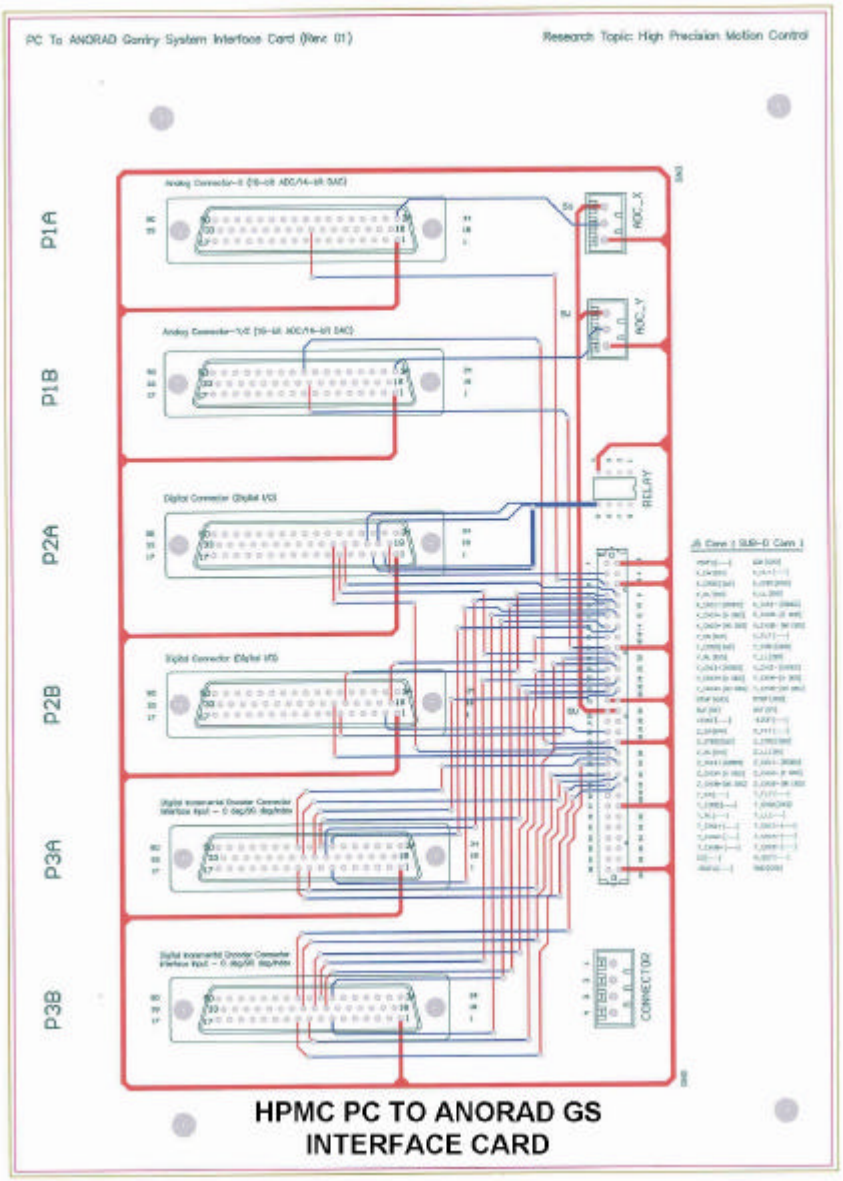




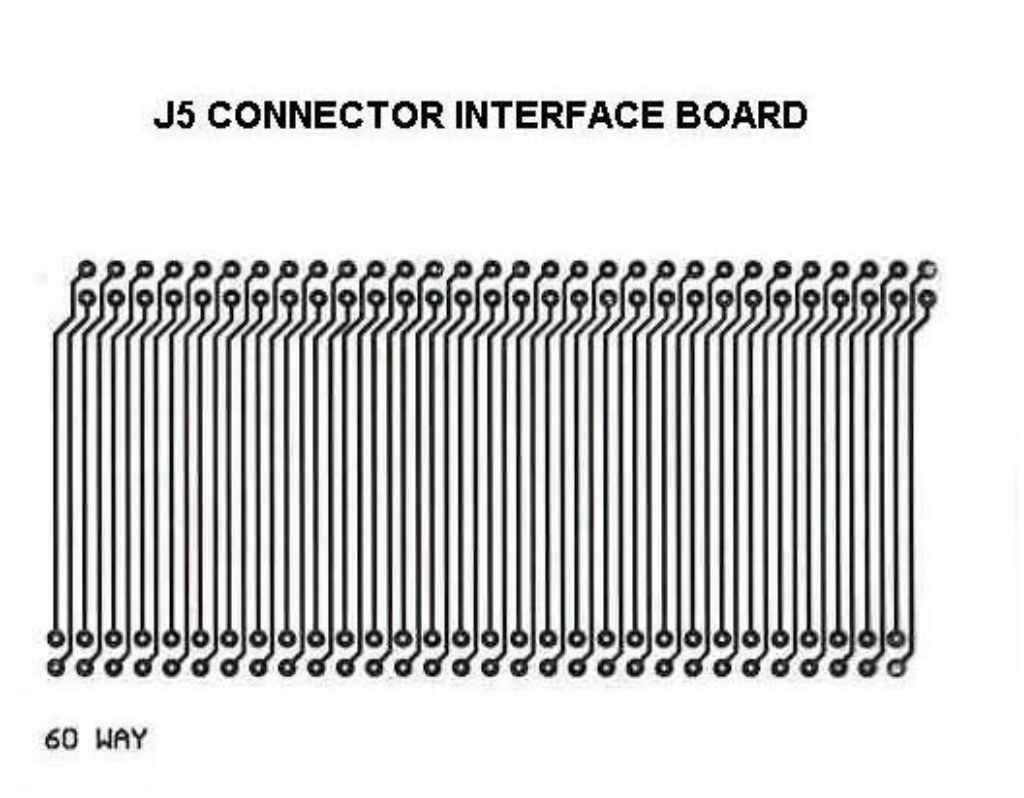
X/Y/Z AXIS DRIVER INTERFA
J5 CONNECTOR

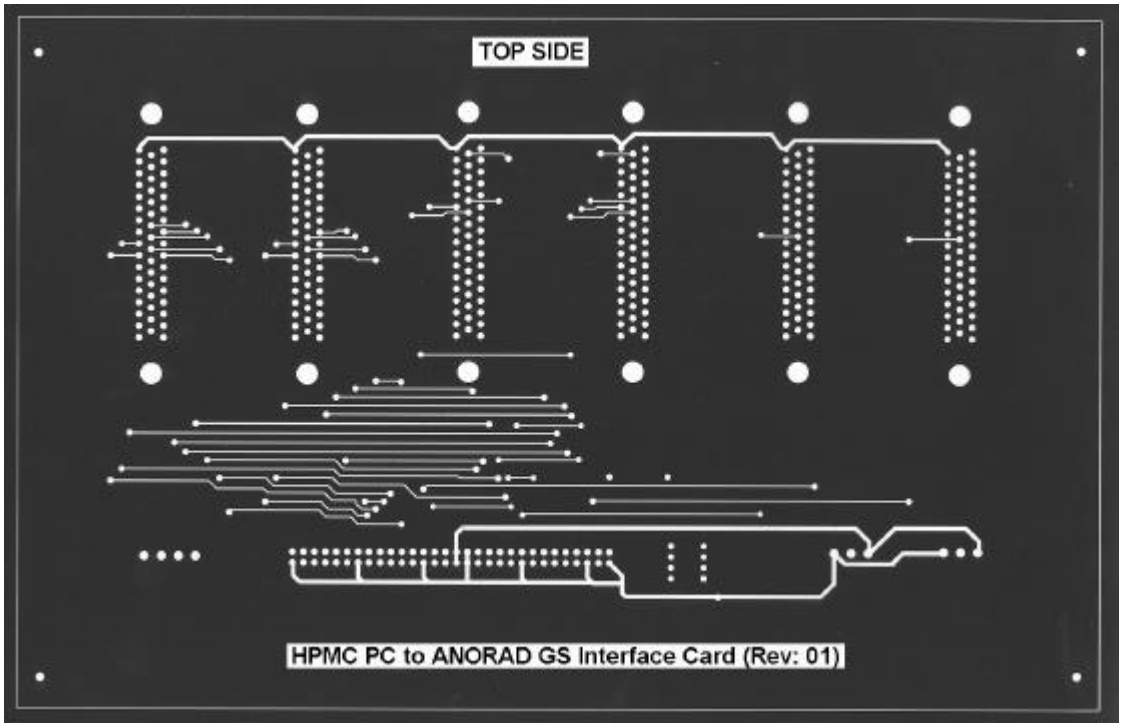

60 WAY
RELAY CIRCUIT
Z_AXIS DRIVER
FEEDBACK A_X
FEEDBACK A_Y
X/Y/Z-AXIS DRIVER INTERFACE CARD
Research Topic: High Precision Motion Control
6299.213mil
5118.11mil

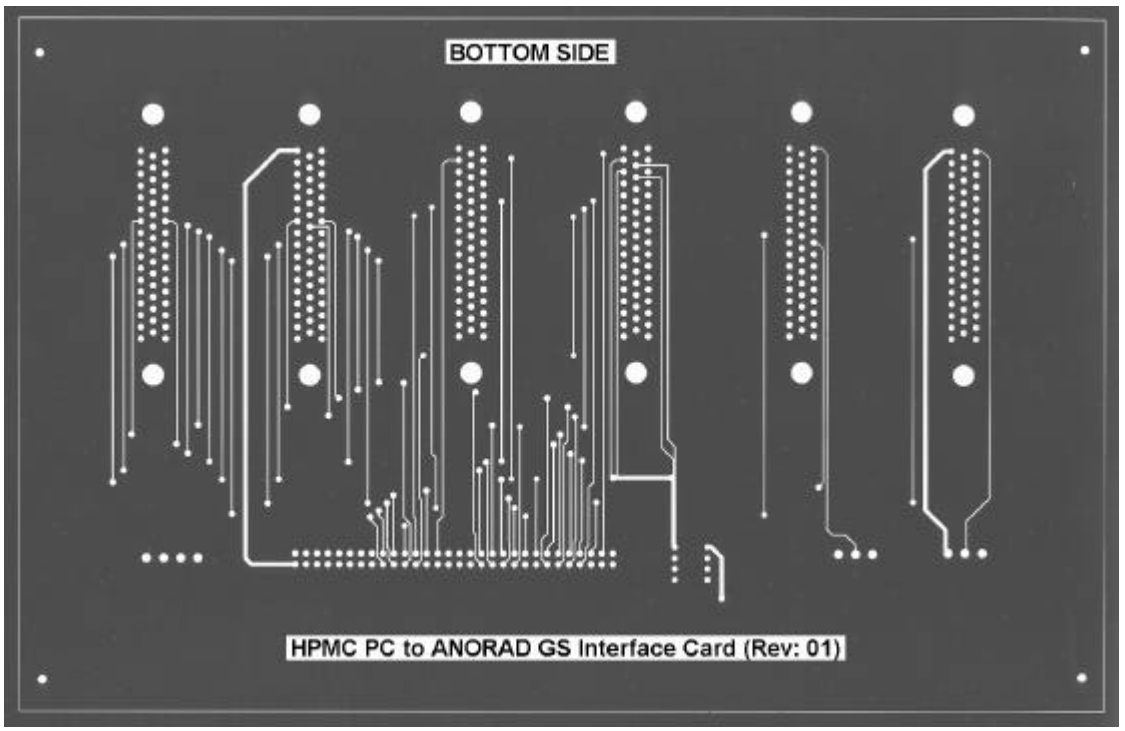



PC To ANORAD Gantry System Interface Card (Rev: 01)
Research Topic: High Precision Motion Control
P1A
P1B
P2A
P2B
P3A
P3B
ADC_X
ADC_Y
RELAY
CONNECTOR
HPMC PC TO ANORAD GS
INTERFACE CARD

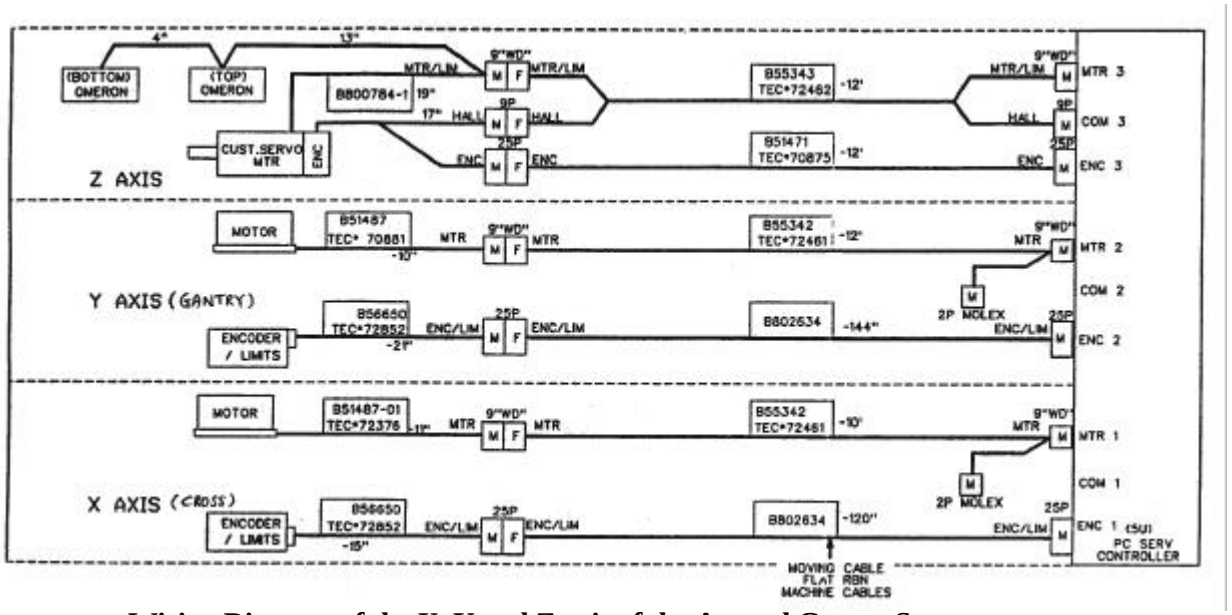
Appendix 4: PCB Photo-plots




TOP SIDE
HPMC PC to ANORAD GS Interface Card (Rev: 01)

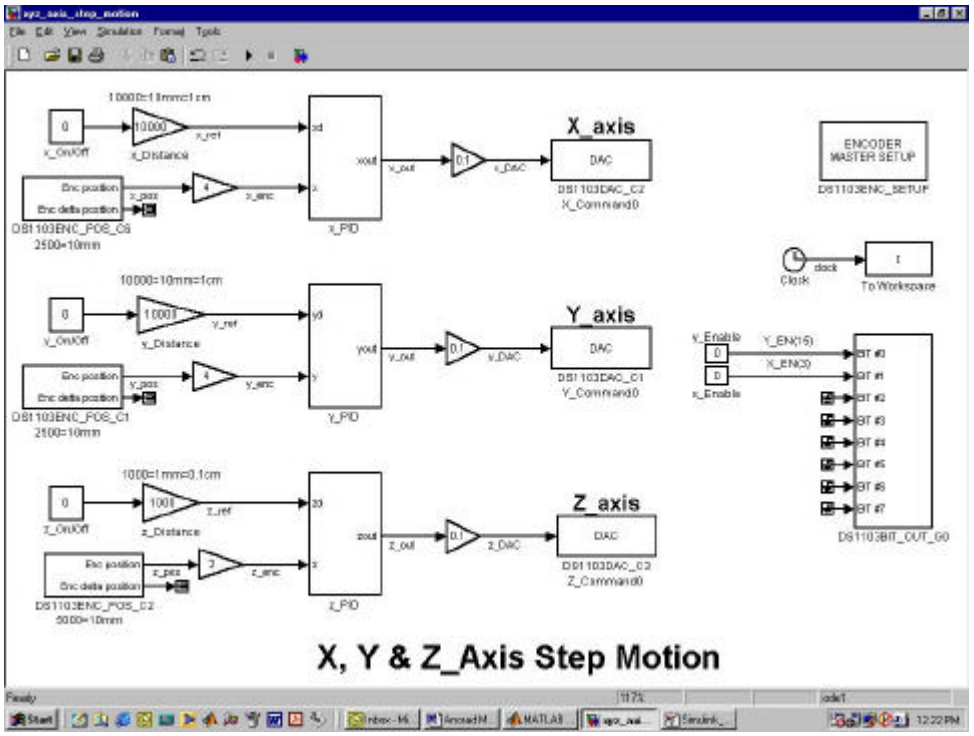

BOTTOM SIDE
HPMC PC to ANORAD GS Interface Card (Rev: 01)

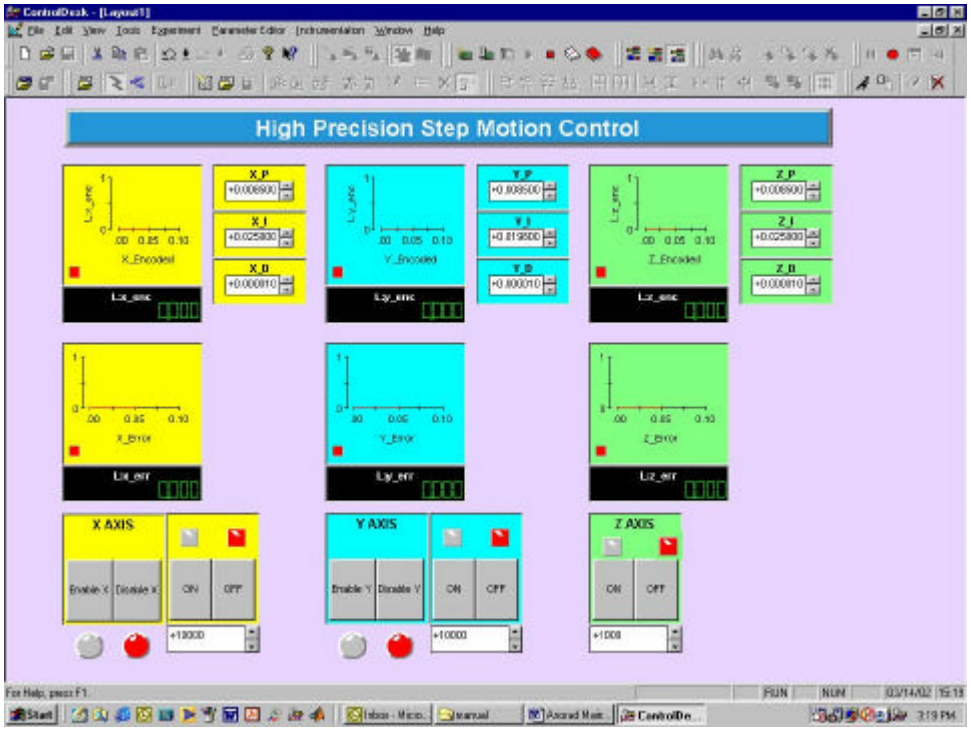
Appendix 5: Wiring Diagrams

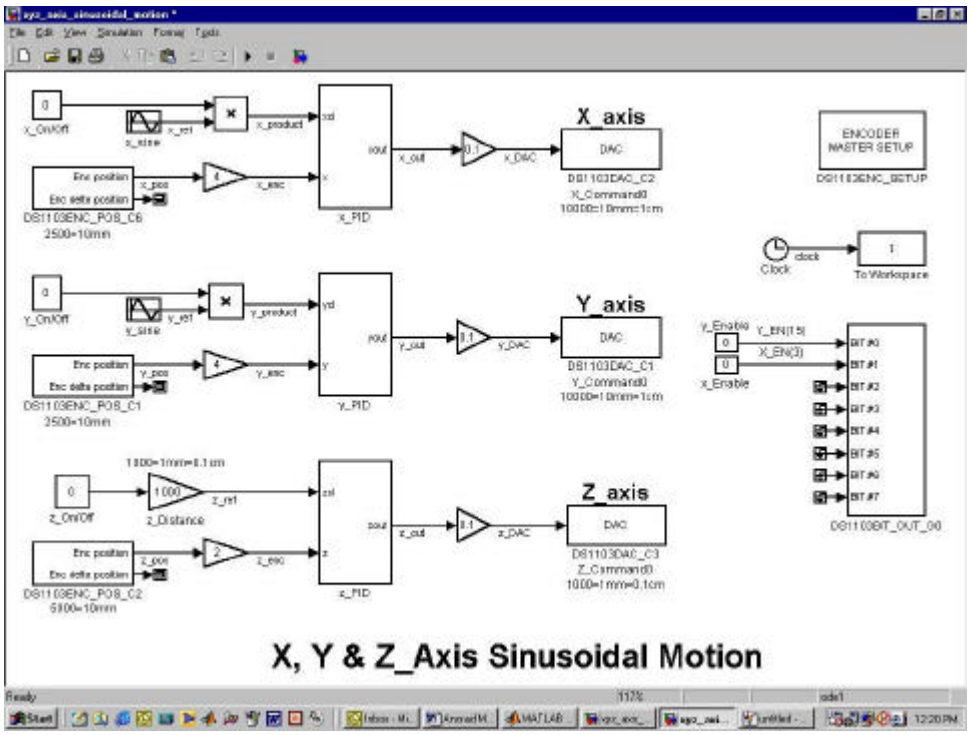


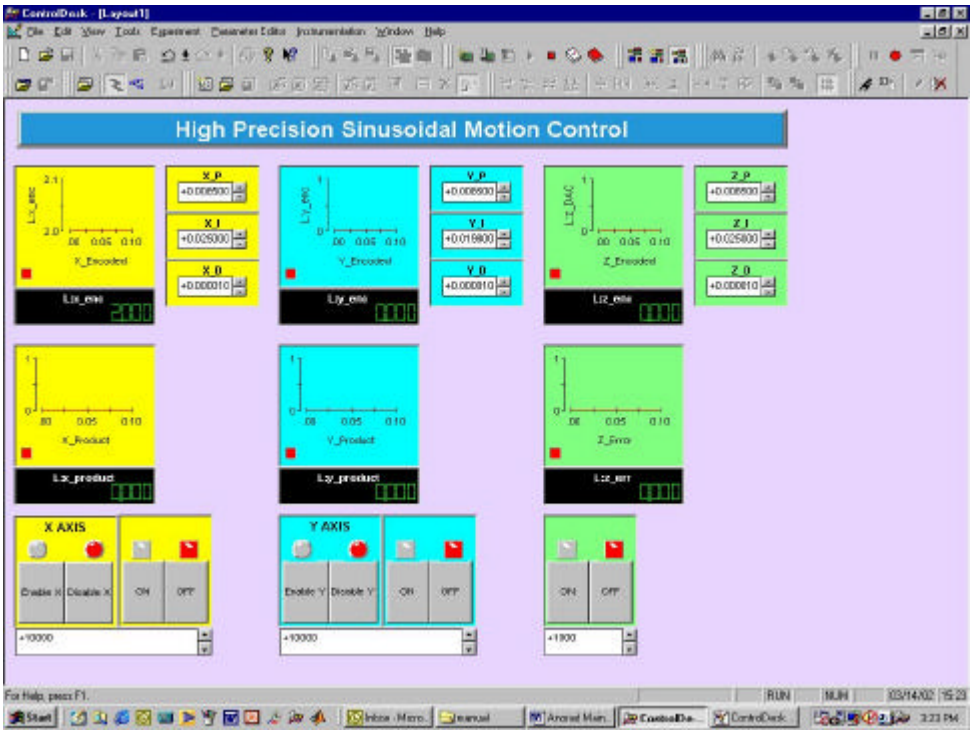
Wiring Diagram of the X, Y and Z axis of the Anorad Gantry System

Appendix 6: Simulink/ControlDesk Programs

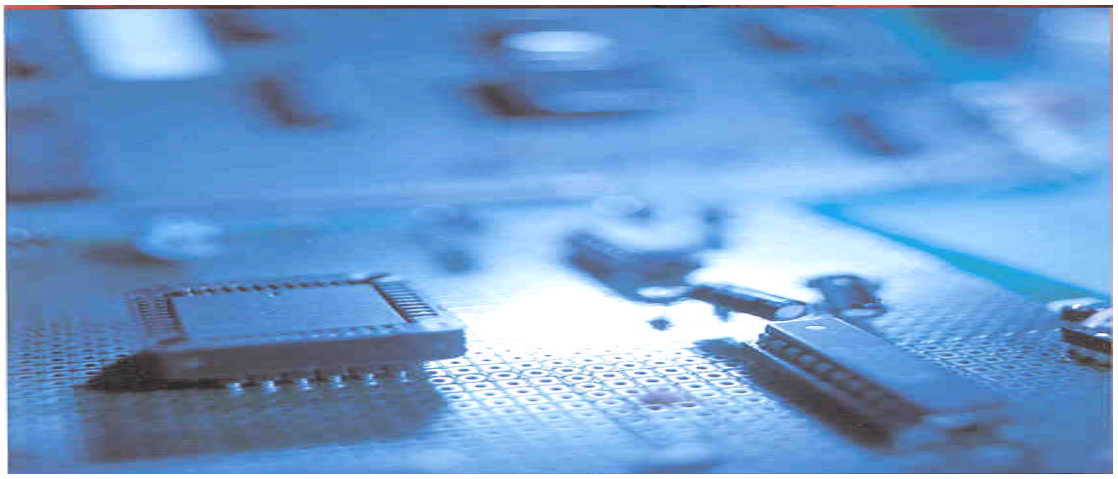





X_axis
Y_axis
Z_axis
ENCODER MASTER SETUP
X, Y & Z_Axis Sinusoidal Motion


High Precision Sinusoidal Motion Control
X AXIS
Y AXIS

Appendix 7: Datasheets



For detail Datasheet of **Elmo SAX 5/230 digital driver**, refer to the website:
www.elmomc.com/support/datasheets-files/LEF_SAX_EN_0500.pdf

For detail Datasheet of **Elmo PIC 15/200 brushless motor driver**, refer to the website:
www.elmomc.com/support/datasheets-files/LEF_PIC_EN_0500.pdf

For detail Datasheet of **dSPACE DS1103 controller board**, refer to the website:
http://www.dspace.de/Download/PDFFiles/Products/07_1103.pdf

For detail Datasheet of **ROBO-678 single board computer**, refer to the website:
http://www.portwell.com.tw/robo-678.htm